I. C. 7454

OCTOBER 1948

UNITED STATES
DEPARTMENT OF THE INTERIOR
J. A. KRUG, SECRETARY

BUREAU OF MINES
JAMES BOYD, DIRECTOR

RECEIVED
NOV 8 - 1948
O. S. U. LIBRARY

INFORMATION CIRCULAR

SAFE EQUIPMENT, GUARDS, AND PRACTICES
LAKE SUPERIOR DISTRICT IRON-ORE MINES

BY

FRANK E. CASH AND MAX S. PETERSEN

Generated on 2024-09-19 19:15 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

Digitized by Google

Original from
THE OHIO STATE UNIVERSITY

I. C. 7454,
October 1948.

INFORMATION CIRCULAR

UNITED STATES DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

SAFE EQUIPMENT, GUARDS, AND PRACTICES, LAKE SUPERIOR DISTRICT IRON-ORE MINES[1]

By Frank E. Cash[2] and Max S. Petersen[3]

CONTENTS

	Page
Introduction	1
Acknowledgments	2
Accident statistics	3
Support of ground	6
Hoisting and haulage	15
Explosives	42
Fire, gases, and ventilation	51
Electrical and mechanical installations	64
Health and miscellaneous	78

INTRODUCTION

The use of safe equipment, safeguards, and safe practices in the mining and allied industries should reduce injuries and improve accident experience.

The object of this report is to give to the mining industry, especially metal mining, a graphic pictorial description of some of the safeguards, equipment, and practices used and followed in the iron-ore mines of the Lake Superior district.

Some of the subject material has been in use or has been established for many years, and some is relatively new. Some of the equipment was purchased commercially, and some was designed by the company employees and constructed in the mine shops. The photographs were taken by the personnel of the Health and Safety Division of the United States Bureau of Mines, primarily for use in the Metal-Mine Accident-Prevention Course of the Bureau of Mines. In general, they are arranged under the following headings or subjects:

1. Accident statistics.
2. Support of ground.
3. Hoisting and haulage.
4. Explosives.
5. Fires, gases, and ventilation.

1/ The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is made: "Reprinted from Bureau of Mines Information Circular 7454." Work on manuscript completed March 1947.

2/ Supervising engineer, Health and Safety Division, Bureau of Mines, Duluth, Minn.

3/ Mining engineer, Safety Branch, Bureau of Mines, Duluth, Minn.

Generated on 2024-09-19 19:13 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

6. Electrical and mechanical installations.
7. Health and miscellaneous.

In taking these photographs, no attempt was made to get "set-up" pictures, but, rather to take photographs of actual operating equipment and practices. In doing this, some pictures which were taken in order to show a view of a noteworthy piece of equipment or practice, unavoidably show undesirable conditions. The selection of a photograph was in some instances influenced by its reproducibility.

The equipment, guards, or practices represented in each of these figures have prevented injuries and have contributed to the commendable safety records of the Lake Superior district.

ACKNOWLEDGMENTS

The privileges, courtesies, and assistance in obtaining the photographs, verifying the descriptive matter, and approving the material for publication is gratefully acknowledged by the authors to the officials and operating personnel of the various mines and plants of the following companies:

The Castile Mining Co.
The Cleveland-Cliffs Iron Co.
Evergreen Mines Co.
The M. A. Hanna Co.
Inland Steel Co.
Inter-State Iron Co.
The Montreal Mining Co.
Oliver Iron Mining Co.
Pickands, Mather & Co.
Snyder Mining Co.

The authors wish to express appreciation also to the officials and employees of the many other companies and mines in the district for permitting and assisting in the taking of numerous additional photographs for possible inclusion in this report, and to members of the Bureau personnel, John A. Johnson and Ellen M. Lundquist, for editing and arrangement, and Anna R. Larsen for arrangement in connection with the report.

Generated on 2024-09-19 19:11 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

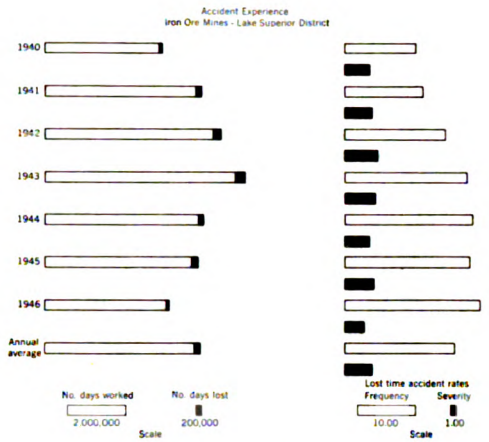


Figure 1. - Accident statistics.

This chart covers the accident experience in the iron-ore mines of the Lake Superior district for the 7-year period 1940 to 1945, inclusive. On the left is shown the number of days worked and lost annually and the average for the 7 years; and on the right are the annual frequency and severity rates with the 7-year average.

Figure 2. - Daily mine record.

Daily record located where men working in and around the mine frequently pass. It is not new, but when the record is changed daily it serves as a constant reminder of the number of days the mine has operated without a lost-time injury.

Generated on 2024-09-19 19:19 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Figure 3. - Bulletin board.

Bulletin board at the entrance to a concentrating plant. Posters, notices, and literature are displayed to stimulate the interest of employees in safety. The material is changed frequently to maintain interest.

Figure 4. - Bulletin board.

This bulletin board appears at the entrance to an open-cut mine. The board is illuminated at night. Safety posters occupy one-half of the space, and the district injury record is portrayed on the other half. This stimulates a competitive spirit to prevent injuries.

Generated on 2024-09-19 19:11 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Figure 5. - Caution sign.

"Cross 30 feet beyond train" serves as a reminder for persons crossing the tracks that the locomotives might move. Even though there is a rule that a whistle and bell signal must be given before moving, the responsibility to prevent an injury is shared by the pedestrian and engine crew.

Figure 6. - Individual responsibility.

A sign in large white letters on a black background provided on a traveling crane in a mine shop serves as a constant reminder that, irrespective of safe equipment and safe guards, the prevention of injuries depends on the individual workmen.

Generated on 2024-09-19 19:14 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

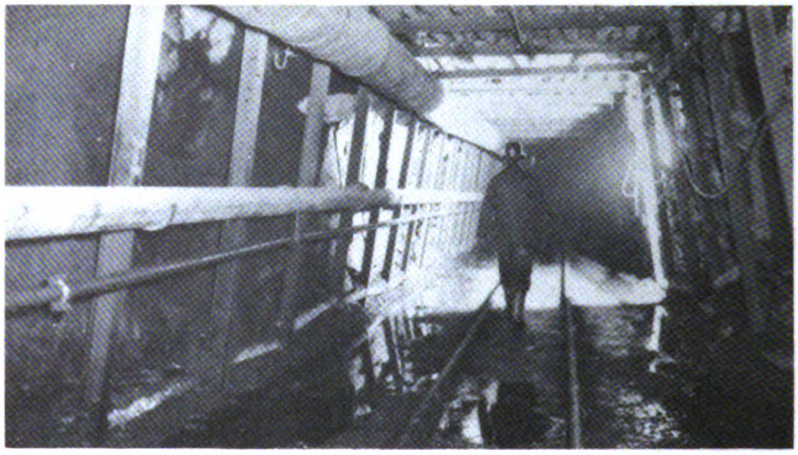


Figure 7. - Drift support.

A main haulage drift, the sides and back supported by 9-foot, 4-inch steel H-beam posts and caps. The sides do not require additional support, but tamarack poles and cedar lagging have been placed over the caps. A 16-inch, spiral, metal exhaust ventilating pipe is supported by 1/4-inch wire rope and clamps, with the water and air lines secured about midway of the length of the posts.

Figure 8. - Timber crib.

In untimbered drifts, where additional width is required for "turnouts" or crosscuts, the back is often supported by timber cribs. These cribs may be made of reclaimed or new timber. In addition to being used in drifts, these cribs are effective around the tops of raises during the last slice on a sublevel when pressure is greatest from the timber gob.

Generated on 2024-09-19 19:10 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Figure 9. - Back support.

A method of supporting the back at the breast in top slicing, to protect the miners during the erection of an advance timber set, is to place forepoles from the last cap to hitches in the breast, with 1-inch headboards placed across the poles. If necessary, spiling poles are driven or placed to protect the miner while cutting the back-pole hitches in the breast. The three-angled poles to the breast are provided for attaching the scraper block.

Figure 10. - Protection for drillmen.

In the "caving back" operation of the sublevel caving system of mining, it is necessary to drill blast holes in ground recently disturbed by caving or blasting. By using long lengths of drill steel to drill the holes, the drill men are able to work in the adequately timbered drift relatively secure from falling or rolling pieces of ore.

Generated on 2024-09-19 19:12 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

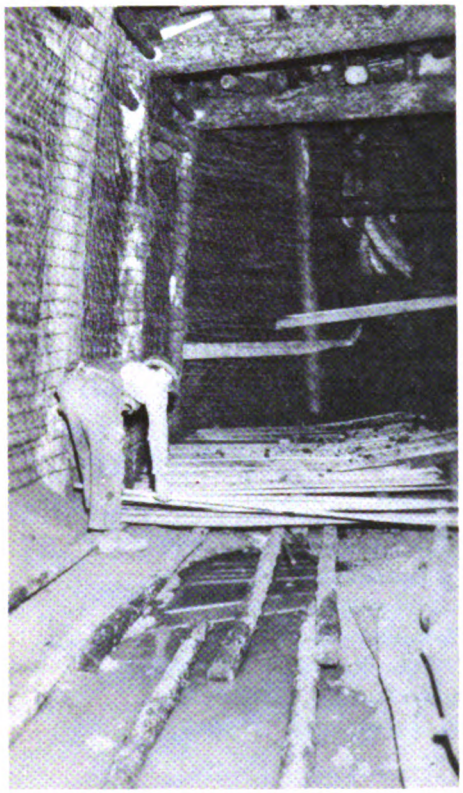


Figure 11. - "Covering."

One method of preparing a slice before it is blasted down. The side of the slice adjacent to the solid ore is covered with heavy-mesh wire, and the floor is covered with 1-inch boards laid across stringers placed lengthwise of the drift. Heavy-mesh wire is then stretched over the boards. These measures aid in holding the gob or caved ground when subsequent slices are driven alongside or beneath.

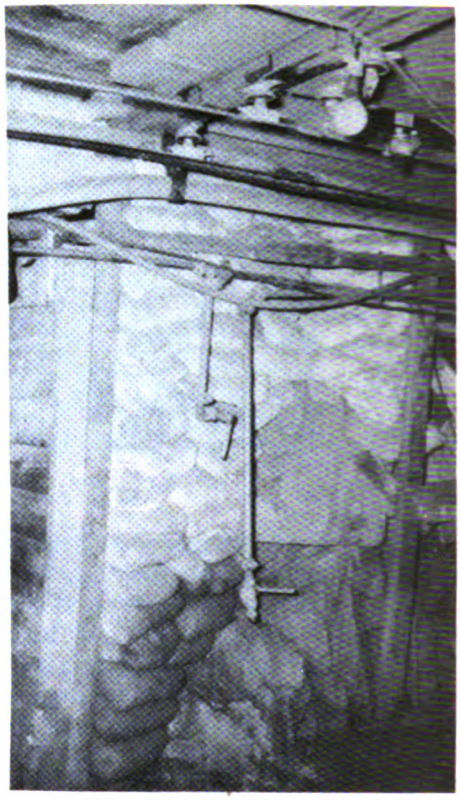


Figure 12. - Steel and concrete.

This demonstrates supporting ground with steel and cement. Here the steel timber sets are "backed up" or reinforced with concrete. The concrete is mixed, put into the sacks, and put in place to set and support the back and sides.

Generated on 2024-09-19 19:11 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Figure 13. - Placing forepoles

One method of reducing injuries from falls of ground is to place forepoles over the last cap and to the breast to support the back after blasting and prior to scraping and timbering operations. The poles in this case are green tamarack, which will not break under a moderate load. Cedar lagging is placed across the poles and blocked snugly to the back.

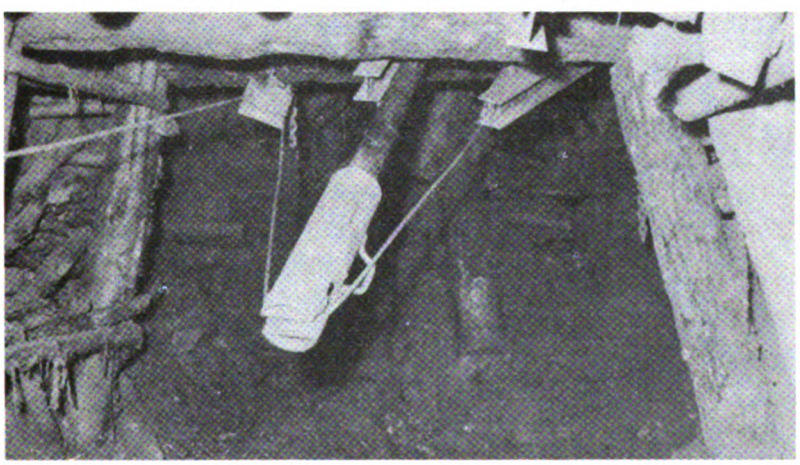


Figure 14. - Driving spiling.

Spiling, or "back" poles, in top slicing to support the back and protect the miners during the erection of breast timber sets, is common practice. The device illustrated utilizes the power of the scraper hoist to push the poles into place. It is made of a 20-inch length of 6-inch pipe with one end slotted to receive a 6-inch pulley. A 2- by 3/4-inch piece of steel is placed through the slots just above the pulley, providing a seat for the spiling poles. Best results are obtained by operating the hoist with short jerky strokes. The mechanism was developed locally and is known as a "Glory-Be."

Generated on 2024-09-19 19:10 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

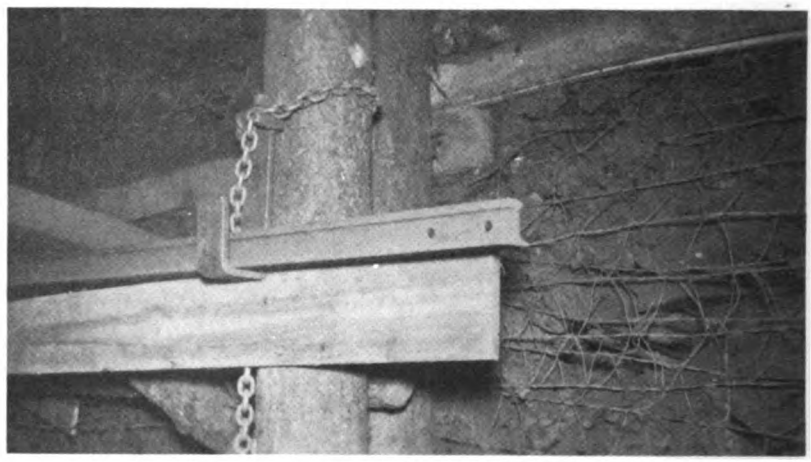


Figure 15. - Staging clamp.

To support staging in top slicing, a chain clamp is used successfully. The clamp is a piece of "J"-shaped metal with teeth on the upper outside, a chain slot at the top, and a chain for fastening the stirrup around the post. To fasten the clamp, the chain is pulled closely around the post and fitted into the slot while the stirrup is held away from the post. As the clamp is pushed down, the chain is tightened and the teeth are imbedded in the post. Four clamps support two rails, one on each side of the drift, across which the staging planks are placed.

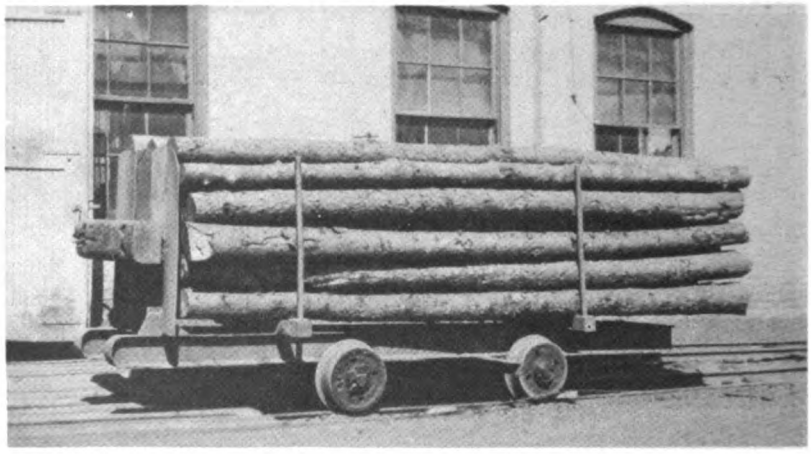


Figure 16. - Timber truck.

Timber truck used to transport timber from the surface to the underground. The truck is loaded in the timber yard on the surface. Chains and clamps are used to secure the load to the truck. The rounded ends of the steel members of the truck frame engage slots in the cage bottom when the truck is placed in a vertical position on the cage.

Generated on 2024-09-19 19:11 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Figure 17. - Forepole hitches.

For providing hitches for forepoles in the breast, an auger drill is frequently used where the nature of the ground will permit. The drill is operated over the cap on which the poles are to rest, using drill steel long enough to permit drilling the holes from under and using the protection of the previous set of timbers. In extremely weak ground, which may "run" before the timber set can be erected, the poles are frequently installed prior to blasting the round.

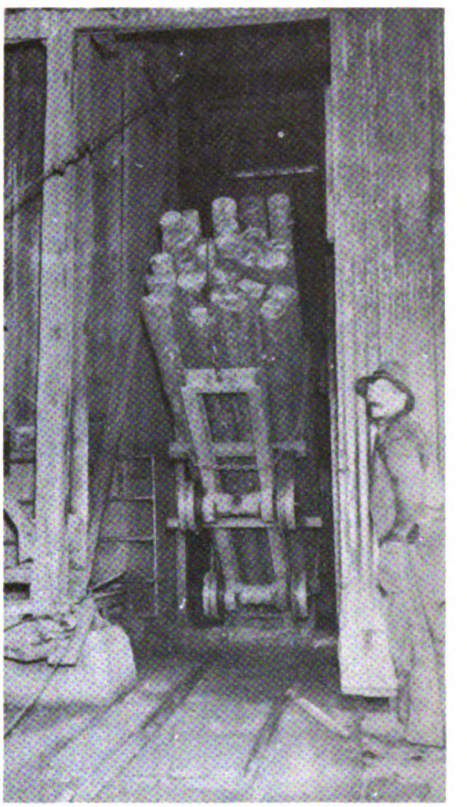


Figure 18. - Transporting timber.

This is the timber truck shown in figure 16 as it is being loaded on the cage for lowering underground. The chains and clamps are shown in place around the truck and load. The loaded truck is raised to a vertical position by a hoist on the headframe floor.

Generated on 2024-09-19 19:14 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

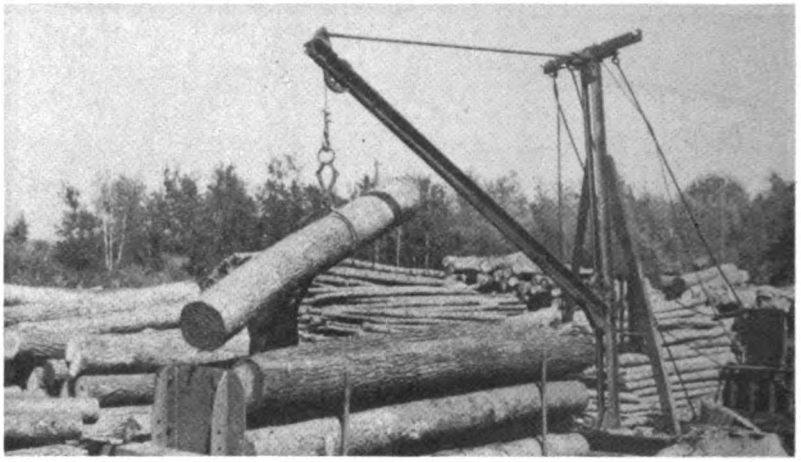


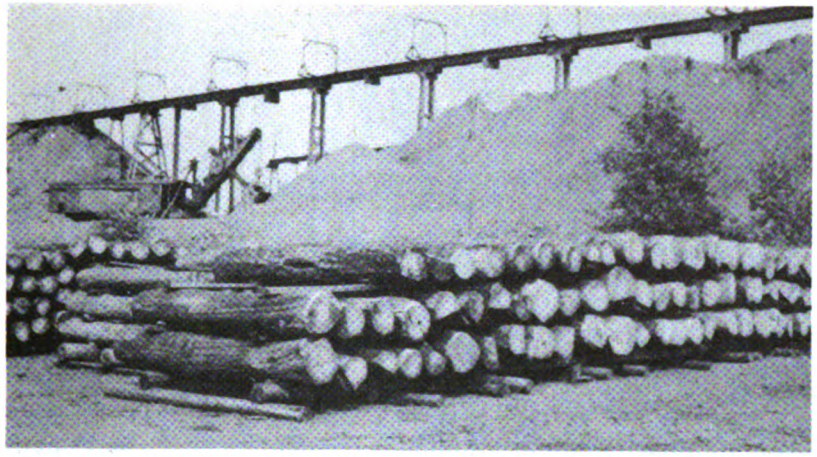
Figure 19. - Portable timber derrick.

This derrick, or "timber loader," is used in the surface yard to load timber on trucks for transportation underground. The derrick is mounted on a truck that operates on standard mine track and is powered by an electric hoist, which is shown at the extreme right.

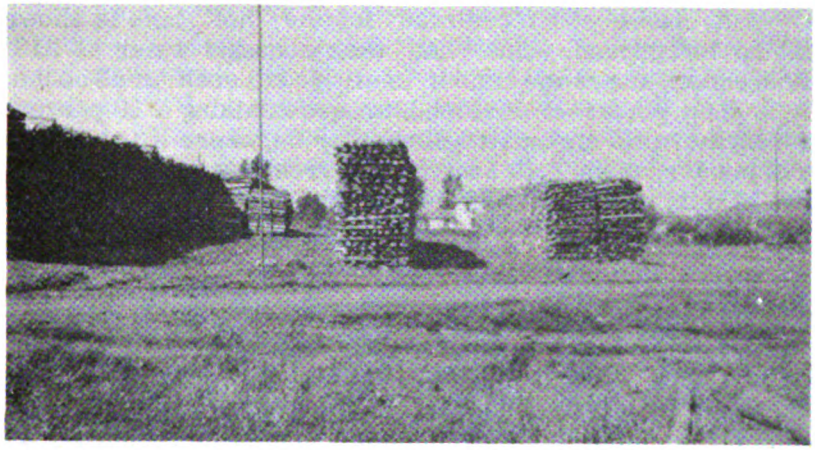
Figure 20. - Timber truck.

Truck used to transport timbers underground. The stakes, or standards, can be folded down parallel to the truck by removing a pin at the base, thus facilitating loading and unloading.

Generated on 2024-09-19 19:14 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY



A.



B.

Figure 21. - Timber storage.

Here orderly and efficient surface-yard storage of underground timber is exemplified.

"A" - The caps and posts are peeled and framed and are stacked for drying prior to treatment.

"B" - These timber piles contain 6-foot cedar lagging, which is either round or split.

Generated on 2024-09-19 19:18 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

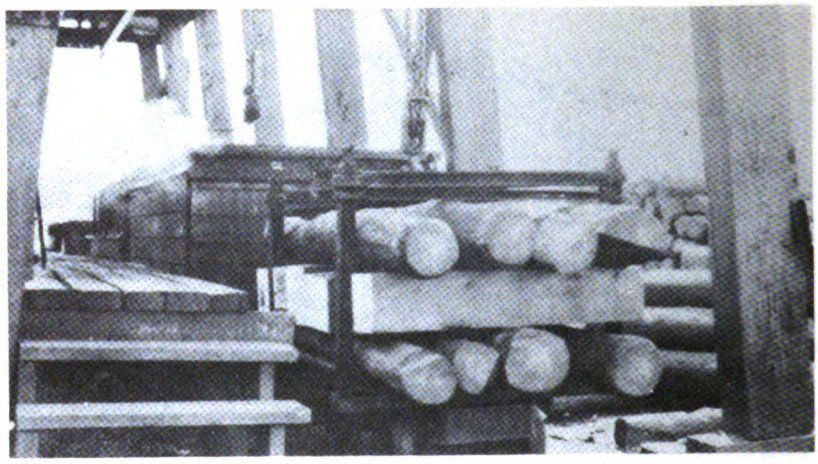


Figure 22. - Timber-treatment plant.

A cradle of timber ready for the "hot" tank is shown in the foreground. The "hot" tank contains water at 210° Fahrenheit, where the timber is allowed to soak for 12 hours. It is then placed in a second tank, containing a 10 percent solution of cold chromated zinc chloride, where it is allowed to stay for another 12 hours. The treatment increases the life of mining timber three to five times.

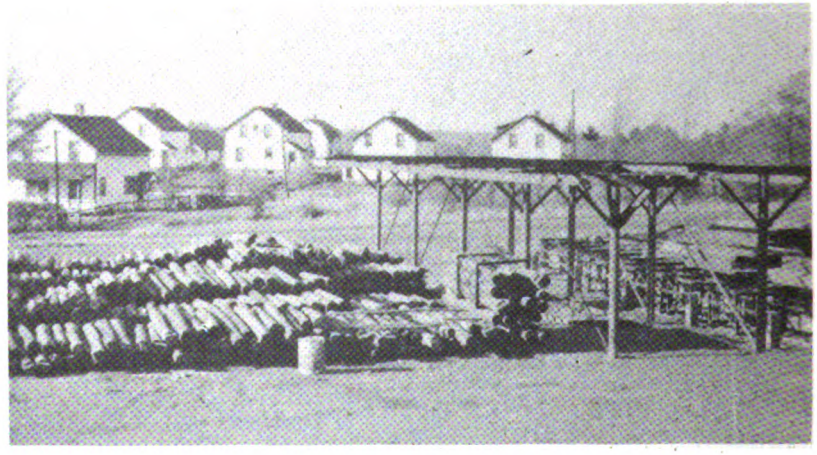


Figure 23. - Timber-treatment plant.

The timber piled at the left is treated and ready for use. An overhead monorail crane at the right is used for hoisting the timber into and out of the treatment tanks, which are sunk below ground level. The untreated timber is to the right of the crane and is not shown. The treatment solution is 10 percent chromated zinc chloride and penetrates the timber up to 1-1/2 inches.

Generated on 2024-09-19 19:09 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

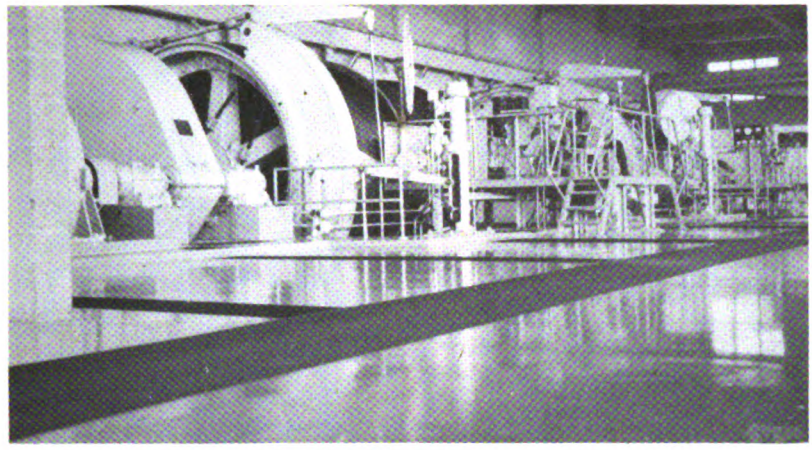


Figure 24. - Hoisting plant.

This is one of the newer and more modern hoisting plants. The room contains, in addition to the other accessory equipment, the skip and cage hoists. The hoists are equipped with General Electric amplidyne control in conjunction with the Ward-Leonard system. The hoist drums are 12 feet in diameter and carry 1-7/8-inch, 6 by 27, type H, flattened-strand, Langlay hoisting cables. The excellent housekeeping is an asset to the modern plant.

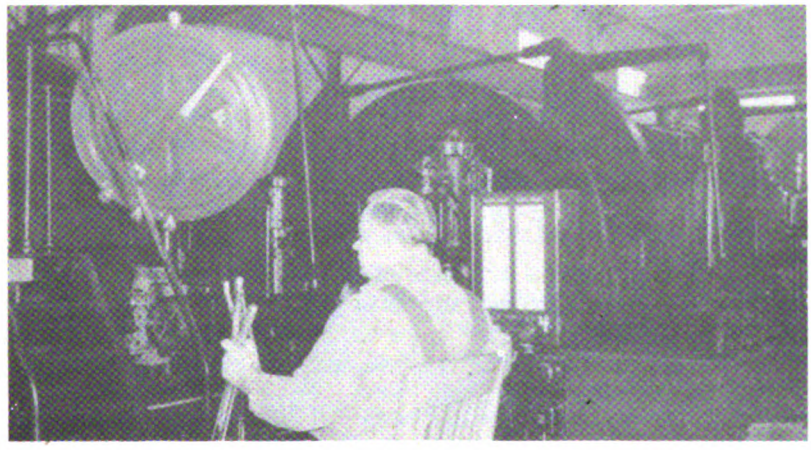


Figure 25. - Annunciator at hoist controls.

An annunciator (white panels at the right of the engineer) indicates the level from which a hoisting signal originates by flashing the level number on the white illuminated screen. This is a safeguard against the cage being moved on a signal from a level other than where the cage is located.

Generated on 2024-09-19 19:09 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

A. B.

Figure 26. - Tripping devices for cage safety catches.

Two of the several devices used to test the effectiveness of safety catches on mine cages periodically are shown in figure 26. These catches are tested monthly by the slack-rope, drop-test method.4/

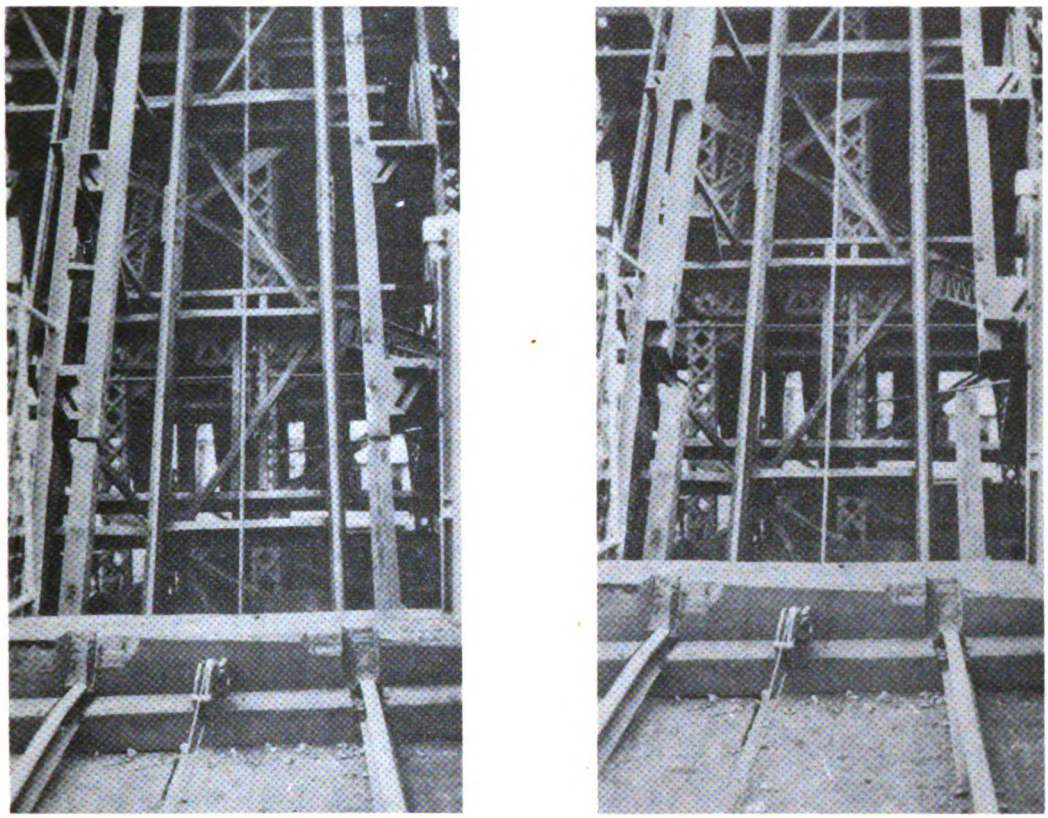
"A" - Two 40-pound rails are placed across the shaft at the collar, and the cage is lowered on the rails. Enough slack is pulled in the hoisting rope to permit connecting the tripping device. The cage is hoisted until it is suspended by the device, or about 3 feet; the device is tripped, and the cage, freed of support, drops until it is stopped by the safety catches.

"B" - The cage support is two 12- by 12-inch timbers placed across the shaft at the collar. The hoisting rope is disconnected from the cage, and the tripping device is installed between the rope socket and the cage. The cage is hoisted a few feet above the timbers, the device is tripped, and the cage is allowed to fall until the safety catches function.

Twenty to thirty minutes are required to make these tests, and if the catches function in a drop of 3-1/2 inches or less their action is satisfactory.

4/ Pearce, Clyde M., and Cash, Frank E., Testing Safety Catches on Mine Cages, Lake Superior District: Bureau of Mines Inf. Circ. 7325, 1945, 12 pp.

Generated on 2024-09-19 19:09 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY



A. B.

Figure 27. - Retractable shaft guides.

This depicts a set of retractable guides at the collar of an inclined shaft to permit the changing of skips and cages.

"A" shows the guides in the normal operating position.

"B" shows the guides in a "retracted" position, which allows change of equipment. The cage or skip is lowered onto the surface track over a set of curved rails placed over the shaft connecting the shaft rails and the surface track. The guides are moved by means of a compressed-air cylinder, and the direction of the movement is controlled by slotted steel plates attached to the guides.

Generated on 2024-09-19 19:09 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

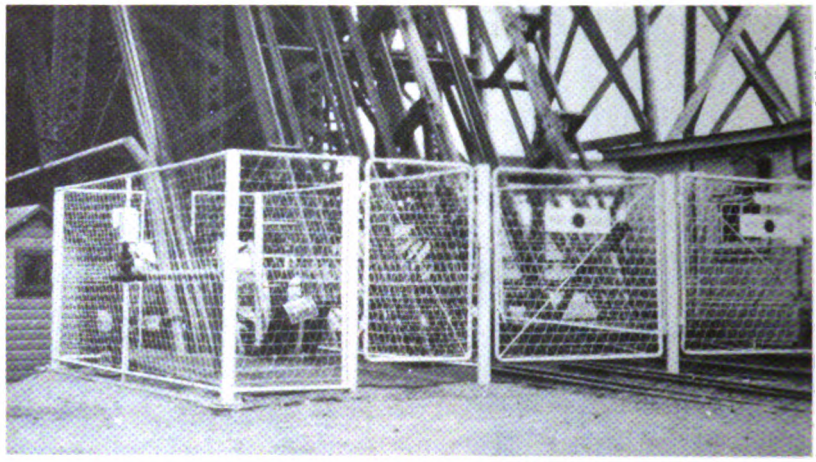


Figure 28. - Surface shaft enclosure.

The enclosure arrangements at the collar of an inclined shaft consist of a substantial metal fence, with gates, completely enclosing the opening. A cabinet containing fire hose is outside at the left of the enclosure, and a standpipe protrudes through the fence.

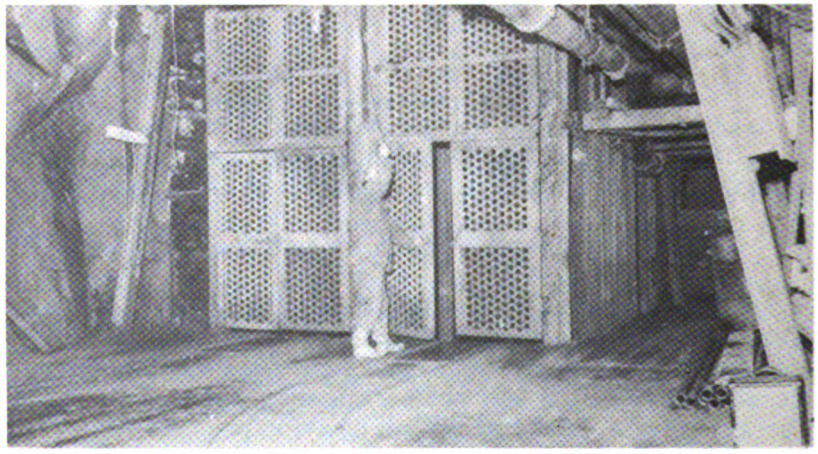
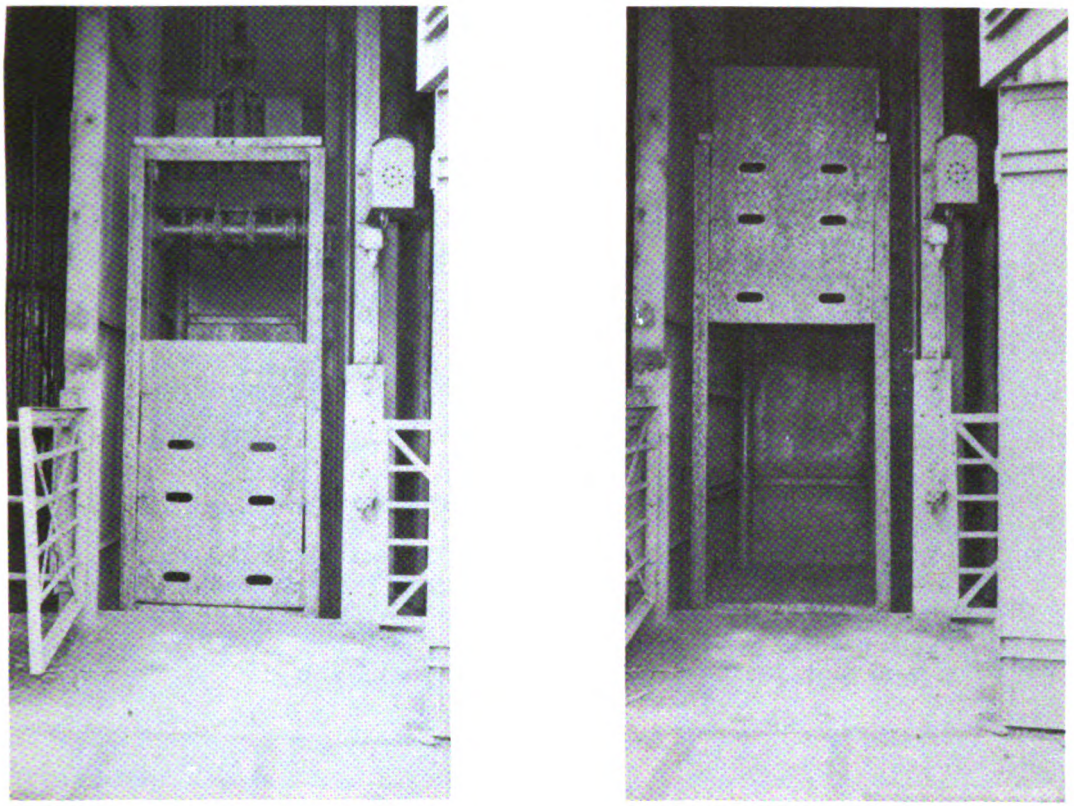


Figure 29. - Underground shaft enclosure.

At an underground shaft station enclosure, the miner is shown closing the gate to the cage compartment and ready to release the cage. A second set of gates, which can be opened when handling long material, is provided above the main gates. Commendable features of the installation include a minimum amount of wood, shaft completely enclosed, and gates extending down to the floor.

Generated on 2024-09-19 19:13 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY



A. B.

Figure 30. - Cage door.

Although a completely enclosed cage is less hazardous than the half-front enclosure, a door to a height that will prevent a man from falling from the cage is essential. The door is metal, slides in vertical grooves at the sides, and is balanced by a counterweight in a pipe on the rear of the cage. The horizontal holes in the door provide handholds for opening and closing. "A" shows the door open, and, "B" shows it closed.

Generated on 2024-09-19 19:12 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

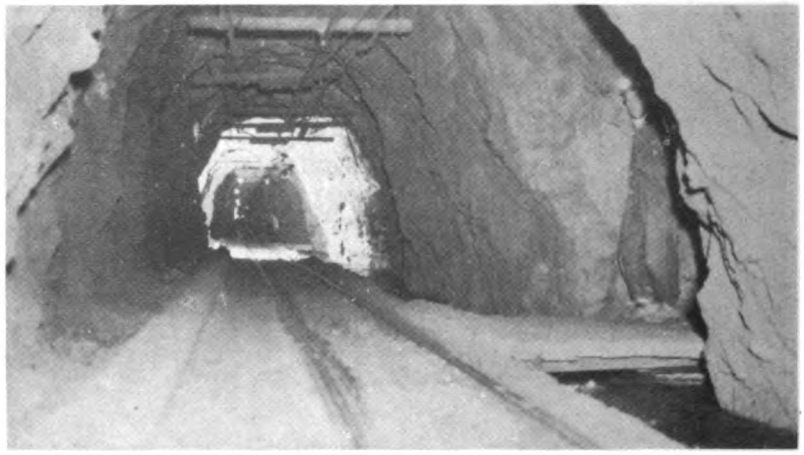


Figure 31. - Main haulage drift.

This main haulage drift does not require timber and, in addition to other desirable features, is provided with shelter holes at 100-foot intervals. The approach to the shelter holes is bridged over the drainage ditch. The location of each shelter hole is indicated by a blue light.

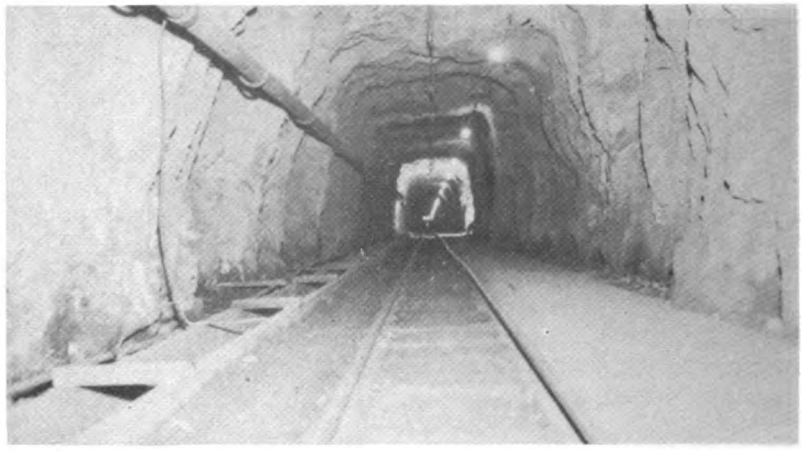


Figure 32. - Main haulage drift.

A well-arranged haulage drift on a main level, in which good housekeeping is in evidence. A board walk is provided on the right side for travel, and ample clearance is provided. The drift is adequately lighted, and the trolley wire is securely suspended 8 feet above the track, eliminating the necessity for guarding the wire. An air line is secured on the left side of the drift, and the drainage ditch underneath is boxed.

Generated on 2024-09-19 19:16 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Figure 33. - Cage door.

A combination sliding and swinging door on a man cage in a vertical shaft. The sliding section is suspended from an overhead track attached to the swinging section. For entrance or exit, the sliding section is opened. For transportation of timber trucks or large equipment, the entire door can be swung back and secured with a latch.

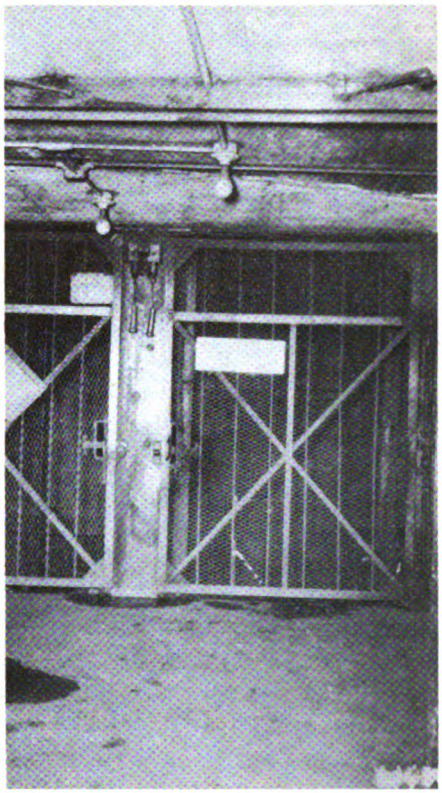


Figure 34. - Shaft station gate.

Station gate to the cage compartment of a vertical shaft. It is a metal frame covered with expanded metal screen. The door covers the opening completely and reduces the hazard from objects falling or rolling into the shaft.

Generated on 2024-09-19 19:14 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

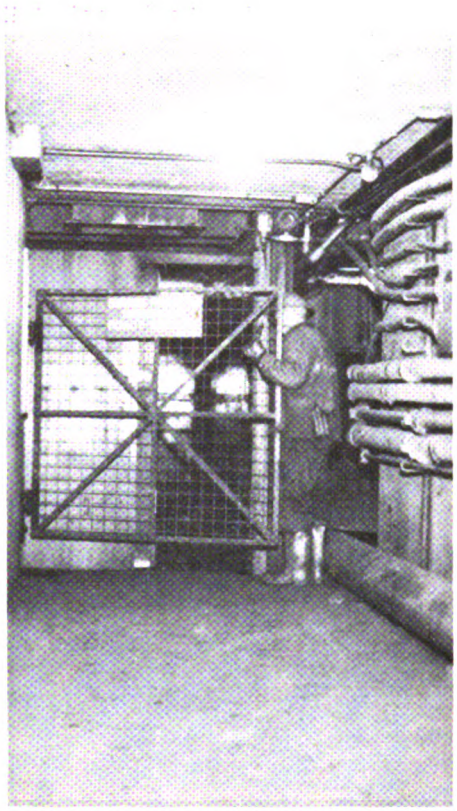


Figure 35. - Shaft station gate.

Shaft gate to the cage compartment at the end of the tunnel from the change house. This loading point is used exclusively for men, and a similar tunnel is provided below, so that both cage decks can be loaded or unloaded simultaneously. Note the "No Smoking" sign on the gate and the securely suspended pipes and electric cables on the right side of the tunnel.

Figure 36. - Larry car.

The larry car in position under the skip dump is used to transport ore from the shaft to a bin at the crushing plant. It operates on a circular track, traveling in one direction only. A two-trolley-wire system is so arranged that the shaft attendant operates the car by remote control to a point halfway between the shaft and the crusher, where the crusher attendant, by the same method, operates the car over the crusher feeder and to a point halfway between the crusher and the shaft, where again the shaft attendant takes the control.

Generated on 2024-09-19 19:11 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Figure 37. - Trolley locomotives in tandem.

The two 4-ton trolley locomotives are connected in tandem and are operated from a single set of controls. The ground support in this haulage drift is noteworthy. The caps are 12- x 5-inch I-beams, and the posts are 5-inch H-beams. The sides of the drift are lagged solidly with poles placed between the flanges of the H-beams, and the back is solidly lagged on top of the I-beams.

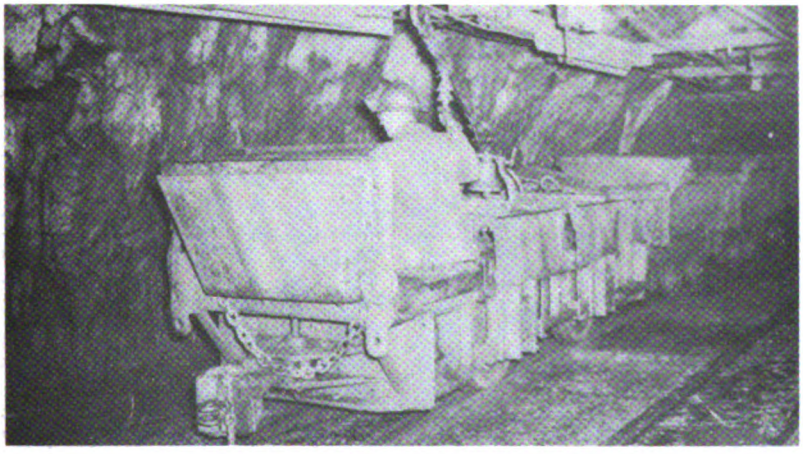


Figure 38. - Trolley locomotive.

An electric locomotive on the main haulage. A "windshield" or, more properly, a guard is provided to protect the motorman in the event of a derailment or wreck. It is a 1/2-inch plate reinforced with angle irons and braced to the frame with a 30-pound rail. Other safety features are (1) a tool basket attached to the windshield, (2) insulated handhold on trolley pole, and (3) canvas cover over motor.

Generated on 2024-09-19 19:13 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

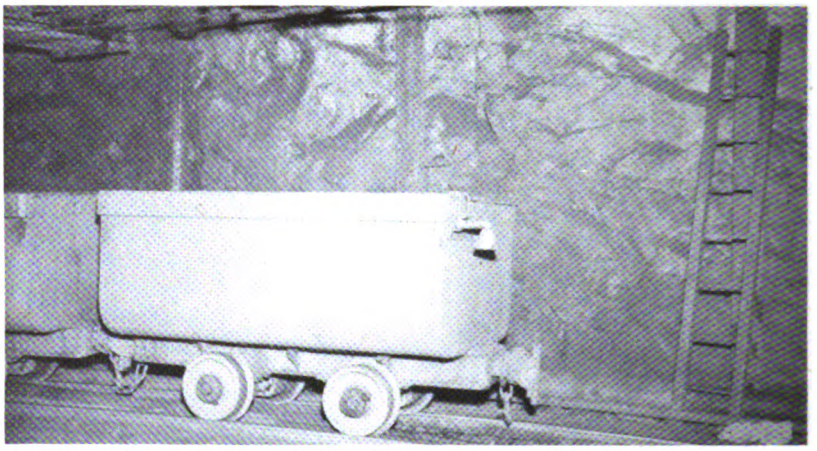


Figure 39. - Haulage warning bell.

Warning bell attached to the last car of a haulage train. It is on a spring sufficiently resilient to allow the bell to ring when the train is in motion. This provides an audible warning on pushed trips.5/

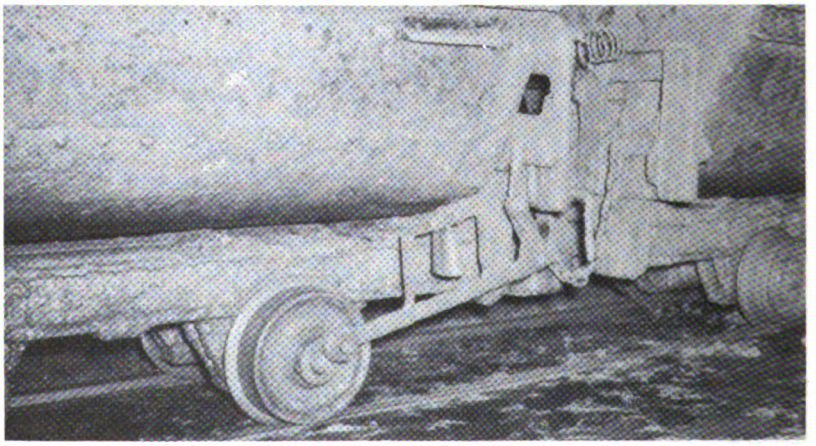


Figure 40. - Haulage warning bell.

Bell attached to a mine car to give an audible warning when the train is in motion. The bell is mounted on an arm suspended between the car body and an eccentric pin on the hub of the wheel. This arrangement imparts a positive motion to the bell when the car is moved.

5/ Johnson, John A., and Cash, Frank E., Transportation of Iron Ore, Underground Mines - Lake Superior District: Bureau of Mines Inf. Circ. 7419, 1947, 22 pp.

Generated on 2024-09-19 19:13 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

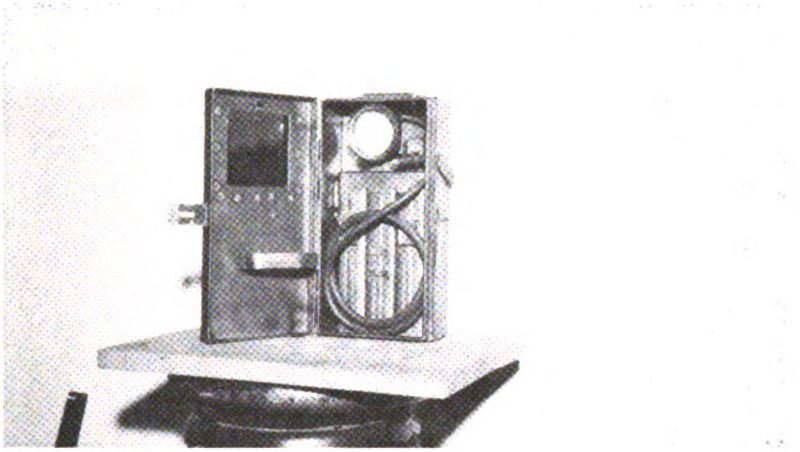


Figure 41. - Trip light.

Trip or train light consisting of a standard electric cap lamp encased in a metal container with a 2-x 2-inch red shatter-proof glass window in the door. The case is made in the mine shop of 14-gage metal and is large enough to hold the complete light. The battery is at the bottom with the cord coiled around the brace on the door, and the headpiece is clipped above the battery. The unit is mounted on a bracket welded to the end of the mine car. At the end of the shift the unit is taken to the lamp house where the used light is replaced by one with a fully charged battery.

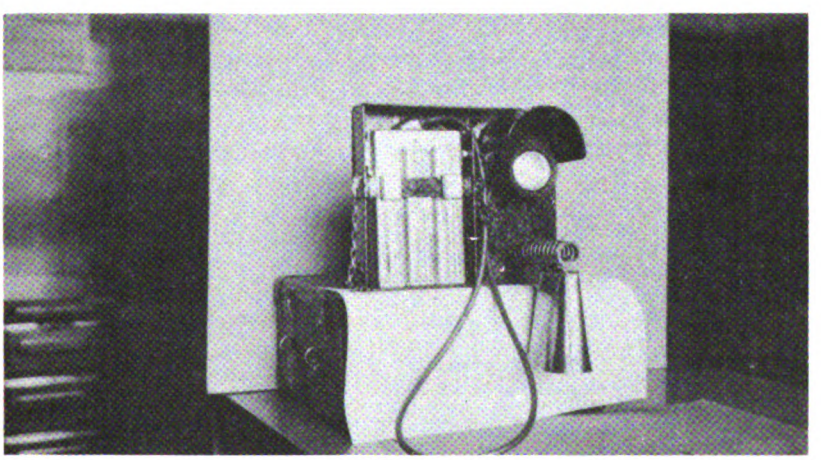


Figure 42. - Bell and trip light.

This unit is a light and bell assembly. The standard electric cap lamp with a red lens serves as the source of light, and a cowbell mounted on a spring provides audible warning. Both light and bell are mounted on a metal base, and the unit is attached to the rear car of the train.

Generated on 2024-09-19 19:11 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

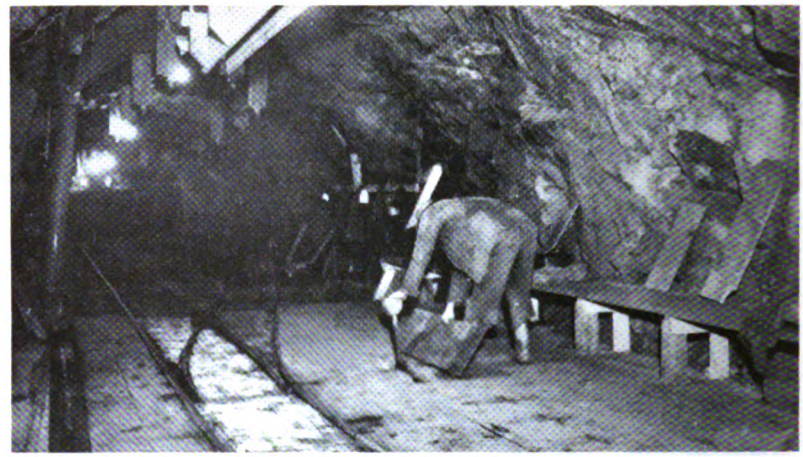


Figure 43. - Guarded track switch.

Parallel-throw track switch recessed in the board floor at the shaft station. The throw is covered by a hinged "flush plate," and the frog and lead rails are blocked. This reduces the stumbling hazard often found around track switches.6/

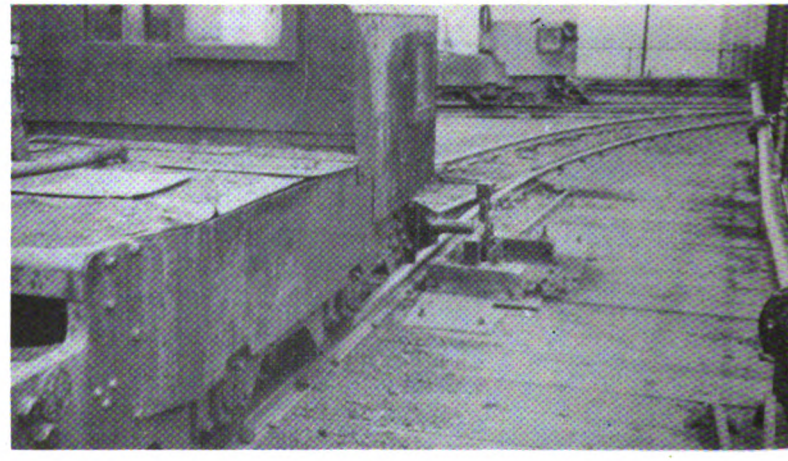


Figure 44. - Automatic switch.

Here is shown a track switch that is operated automatically by a projecting bar on the locomotive. The operating mechanism is an L-shaped member, the vertical arm of which is struck by the motor bar causing a rotation of 90 degrees. This movement is transmitted through a lever rod and bell crank to the switch points.

6/ See footnote 5.

Generated on 2024-09-19 19:15 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

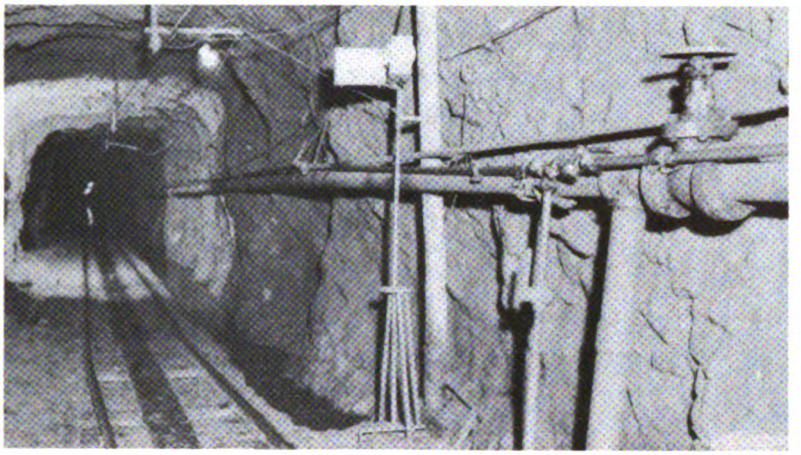


Figure 45. - Switch signal light.

This switch signal light is used to indicate the position of a track switch to the motorman of an approaching train. The signal light is mounted on a stand opposite the switch throw. The vertical shaft on which the lights are mounted is connected to the bridle bar of the switch by arms and levers in such a manner that a rotation of 90 degrees occurs when the switch is shifted from one position to the other. Two light boxes, each containing two light bulbs and colored lenses, are mounted at 90 degrees to each other on the top of the vertical shaft. Thus, when the switch is moved from one position to the other, the opposite colored light is visible from both directions.

Figure 46. - Switch light.

A signal light on a main haulage level to indicate the direction for which the track switch is thrown. The signal is hand-operated, and the lights are situated where they can be seen for a considerable distance from both directions.

Generated on 2024-09-19 19:11 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

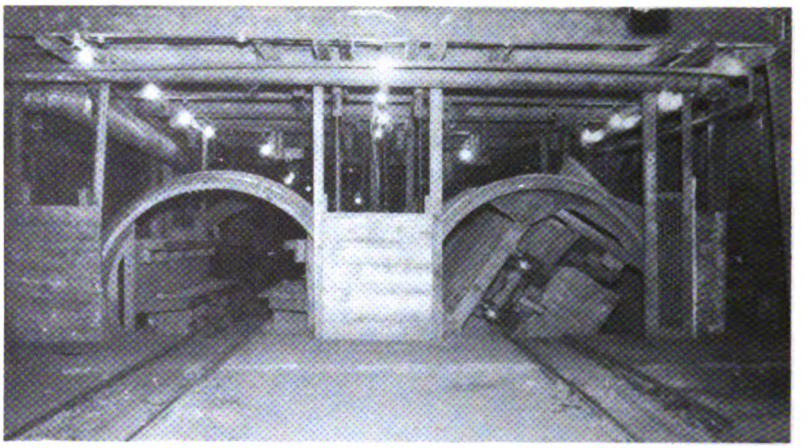


Figure 47. - Rotary dump underground.

Rotary dump at a level shaft station underground. The arrangements at some of such installations permit the cars to be "spotted" by the locomotive and dumped without uncoupling; at others the cars must be uncoupled. A rotary dump has a few disadvantages and many advantages. It speeds dumping and is far less hazardous than other power or hand-dumping methods. The guarding and lighting at this installation is worthy of note.7/

Figure 48. - Man car underground.

Man car used on main levels to transport men from and to their working sections. Seats with full-length back supports are provided on each side, as the trolley wire is high and near the center of the track. The curved irons at the ends of the seats serve as an end arm as well as handholds for mounting and alighting.

7/ See footnote 5.

Generated on 2024-09-19 19:12 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

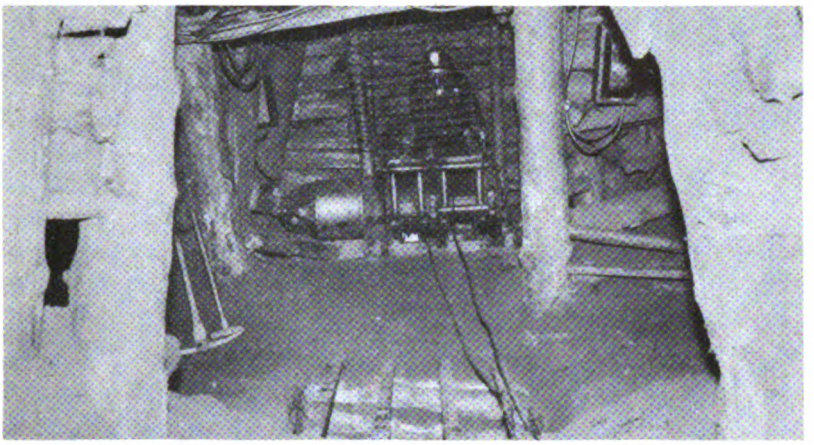


Figure 49. - Scraper-hoist installation.

Here is shown a scraper-hoist installation on a "slusher-sub" in an underground mine. A guard in front of the operator provides protection against a backlash in the event a cable breaks. The operator is wearing safety goggles, a hard hat, a dust respirator, and, although not visible, safety shoes. Closely spaced grizzly rails in the foreground prevent employees from falling into the chute accidentally.

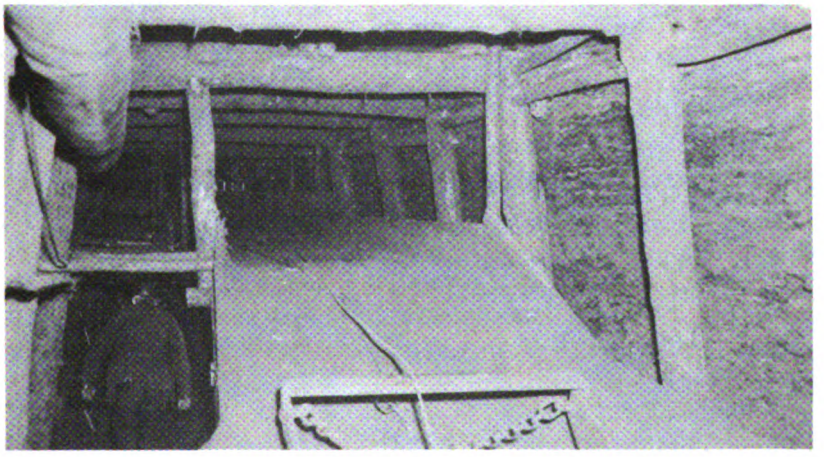


Figure 50. - Scraper slide.

This scraper-loading slide is used where scraping is done on the haulage level. The hoist is mounted on the rear of the slide, which is long enough to accommodate three cars. On the travelway side, the slide is supported by cables attached to rails placed across the caps. The opposite side is supported by posts and braces nailed to the caps and posts. Side boards are provided to prevent material from falling into the drift. The slide can be moved by removing the horizontal braces and lowering the entire unit on a train of cars.

Generated on 2024-09-19 19:15 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

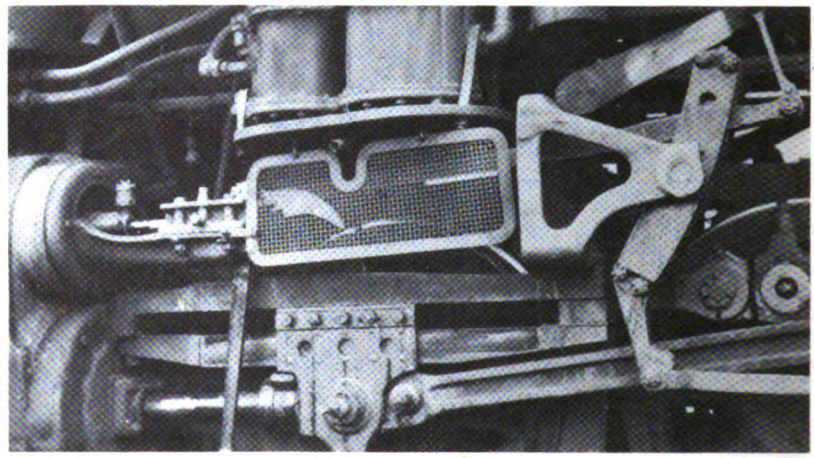


Figure 51. - Locomotive guard.

The movement of the reversing mechanism on a steam locomotive has caused at least one fatality in the Lake Superior district. For the purpose of protecting the locomotive crew during the process of oiling, against the accidental or intentional operation of the reverse mechanism, a screw guard is so installed that it is impossible to get the hands, arms, or other parts of the body into the moving parts.

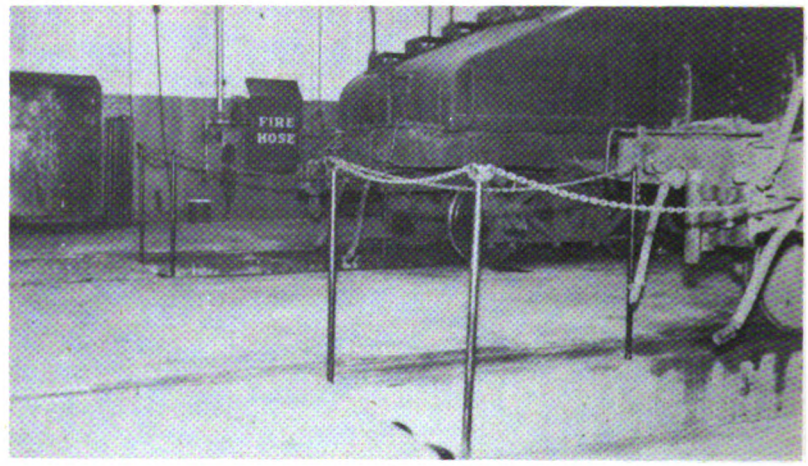


Figure 52. - Guarded repair pits.

A locomotive repair pit equipped with a chain guard to prevent employees from walking or falling into the pit. The uprights fit into holes in the floor or foundation and can be removed quickly when required. This guard is an improvement over the practice of covering the pit with loose boards when not in use.

Generated on 2024-09-19 19:09 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

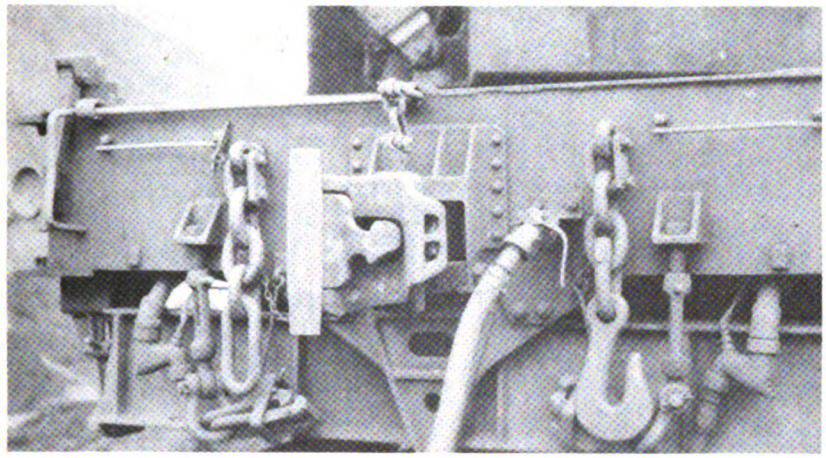


Figure 53. - Safety chains on wrecker.

Standard-gage crane or wrecker used in open-cut mines where haulage is by rail. In addition to the automatic coupler, the wrecker is provided with safety chains, two on each end, for extra safety in attaching the wrecker to the locomotive or train.

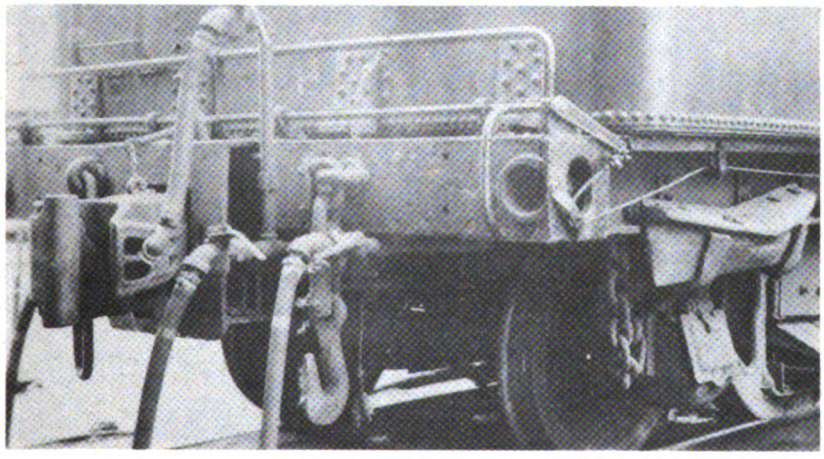


Figure 54. - Coupling-pin lifter.

Locomotive tender equipped with a coupling-pin lifter that can be operated from either side outside the rails and train. The additional convenient and safe feature is that the lifter can be operated by remote control from the gangway of the locomotive. This is accomplished by the arm, pulleys, and steel cable as shown in the center of the illustration.

Generated on 2024-09-19 19:09 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

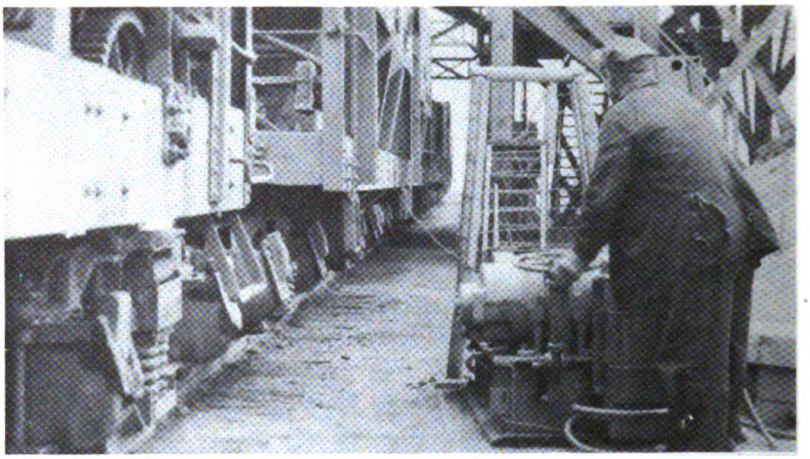


Figure 55. - "Car haul" at loading pocket.

There are various ways of "spotting" cars under loading pockets. This shows an electric hoist installed at an open-cut mine to move the cars under the loading pocket. Although the track is graded to favor the loads, it is sometimes necessary to start the cars moving even when they are spotted by hand or air. This eliminates the necessity of mounting the car or cars once they are in reach of the haul. This can be arranged to handle the cars in both directions. Note the guard in front of the operator to protect against injury due to a backlash from a broken cable.

Figure 56. - Knuckle guard on car mover.

Frequently it becomes necessary to start cars moving under loading pockets after the brakes are released. If power is not available it is necessary to "bump" the car with another from the empty track or to start it with a hand mover. Both methods are hazardous. This car mover is equipped with a metal knuckle guard, which, in the event the mover slips, will protect the hands from striking the ground or the rail.

Generated on 2024-09-19 19:15 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Figure 57. - "Dropping cars."

There are various methods of dropping or spotting cars for loading. This is an example of dropping cars on the loaded track, using a brake stick and safety belt. The belt is leather and is equipped with a "D" ring and a short length of chain that is attached to the brake staff, grab iron, or other place of attachment. Use of the safety belt prevents the brakeman from falling under the car wheels.

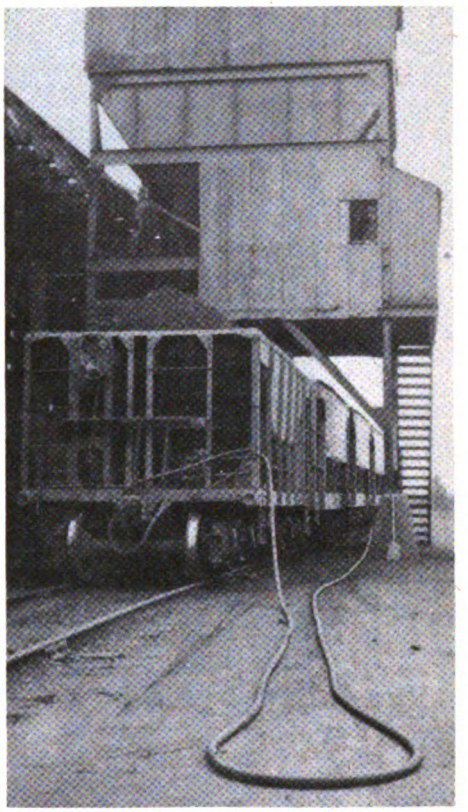


Figure 58. - "Spotting cars."

An arrangement to spot cars under a loading pocket, using air brakes. The brake pipe on the cars is connected to the source of air through a set of control valves at the pocket. Thus, the pocket man controls the brakes and car spotting from his position in the building above the cars. When the cars reach the limit of the air hose, they are either dropped to the storage yard by using the hand brakes or by air braking.

Generated on 2024-09-19 19:15 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

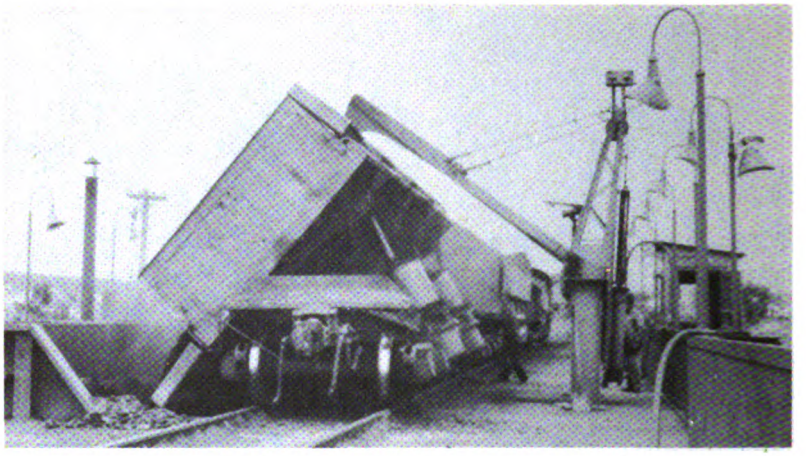


Figure 59. - Dump car stop.

This is a device to stop cars in the dumping operation. Often, in handling wet material or ore frozen and stuck in the car body during the process in dumping, the car overturns or the momentum injures the dumping mechanism. The hook or stop is lowered or raised by four compressed-air cylinders.

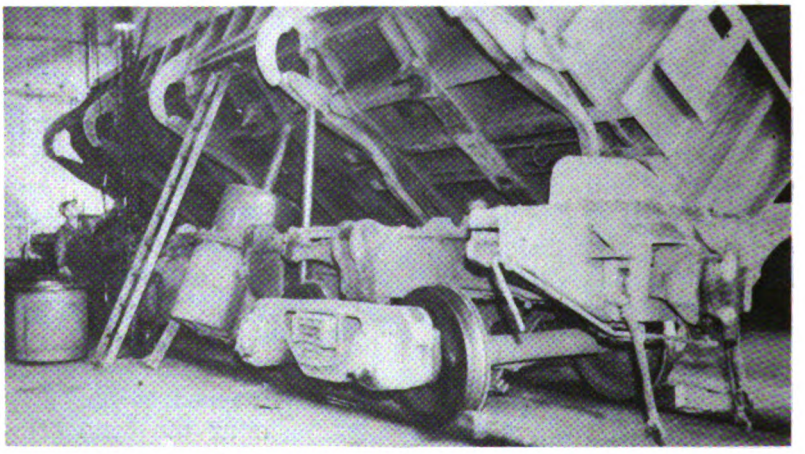


Figure 60. - Repair block for cars.

Dump cars occasionally have to be repaired with the body in a raised or dumping position. A positive block reduces the hazards of the operation. The blocking bar, which is an extra-heavy piece of pipe, can be seen in an almost vertical position to the right of the air cylinder.

Generated on 2024-09-19 19:11 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Figure 61. - Electric haulage.

Electric haulage at an open-cut mine. The locomotive is powered by four 250-horsepower motors operating on 440 volts direct current. The normal load pull is six 75-ton cars.

Figure 62. - Truck-conveyor haulage.

General view of an open-cut mine. Three modes of haulage are used: (1) Truck haulage in the bottom of the pit, (2) conveyor haulage to the surface at the edge of the pit, and (3) electric haulage from the pit bank to the concentrator.

Generated on 2024-09-19 19:09 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Figure 63. - Walkways and crossing points.

This open-cut mine provides and maintains footpaths free from stumbling hazards. The paths are designated by white post markers, and the track-crossing points are indicated by signs.

Figure 64. - Road markers.

In this open-cut mine the road berm is marked by a series of targets. The targets are equipped with fluorescent surfaces, which provide high visibility for night driving.

Generated on 2024-09-19 19:16 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

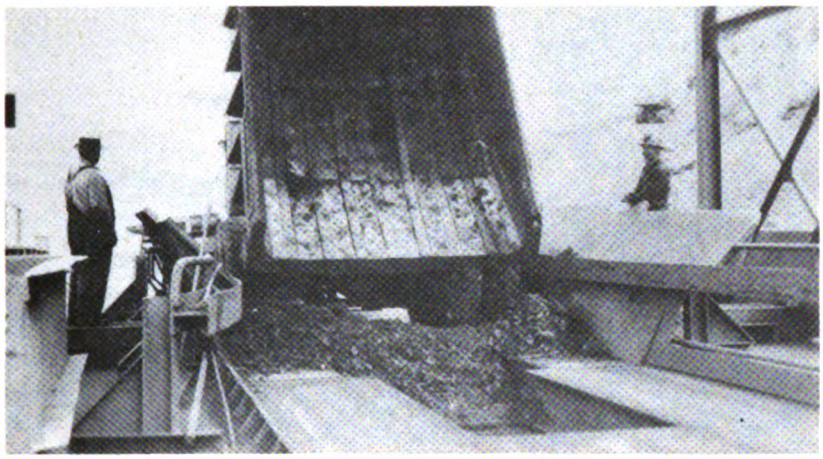


Figure 65. - Cross-over truck dump.

The cross-over dump, where space will allow, saves considerable time in transportation. In this installation, a solid floor is left on each side of the pocket opening for the truck wheels to travel on. Any ore spilled on the solid floor along the sides of the opening is pushed into the pocket by two scrapers operated by a compressed-air cylinder.

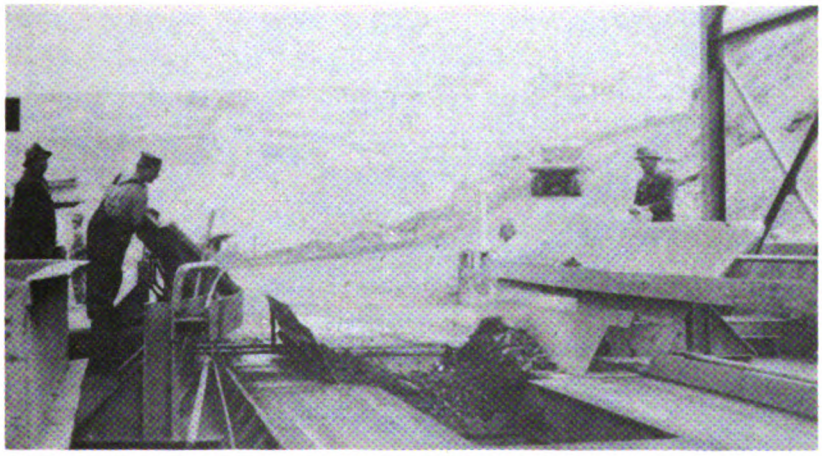


Figure 66. - "Deck swipe."

Device used on the dump shown in figure 65 to clean the spillage on the dump station. This view shows the blades, operated by a compressed-air cylinder, pushing the spillage into the pocket.

Generated on 2024-09-19 19:10 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

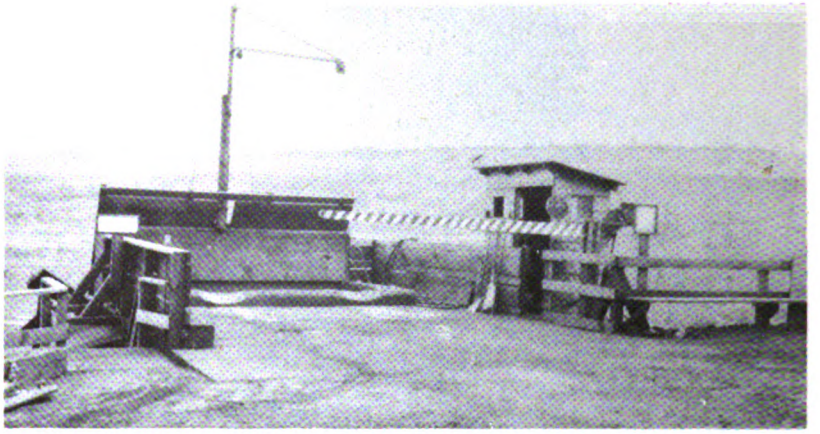


Figure 67. - Semaphore guard at truck dump.

Semaphore guard installed at a truck-dumping ramp in an open-cut mine to signal the drivers and control the movement of trucks. The semaphore is operated by the dumpman through a compressed-air clyinder. When the guard is up, the next truck is free to enter the dump.

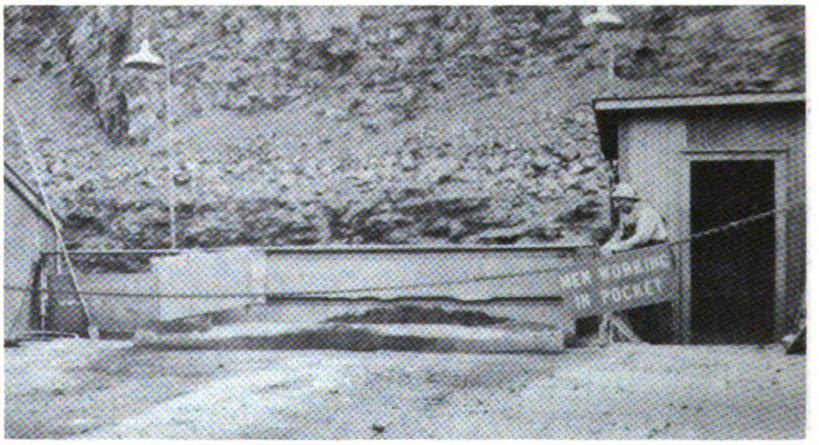


Figure 68. - Chain guard at truck dump.

Chain guard used on a truck-dumping ramp with the sign "Men Working in Pocket" to safeguard the workmen as well as to warn the drivers that the dump is not ready for ore. In addition to the sign and chain, a workman is stationed on the ramp to further protect the men working in the pocket.

Generated on 2024-09-19 19:11 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from
THE OHIO STATE UNIVERSITY

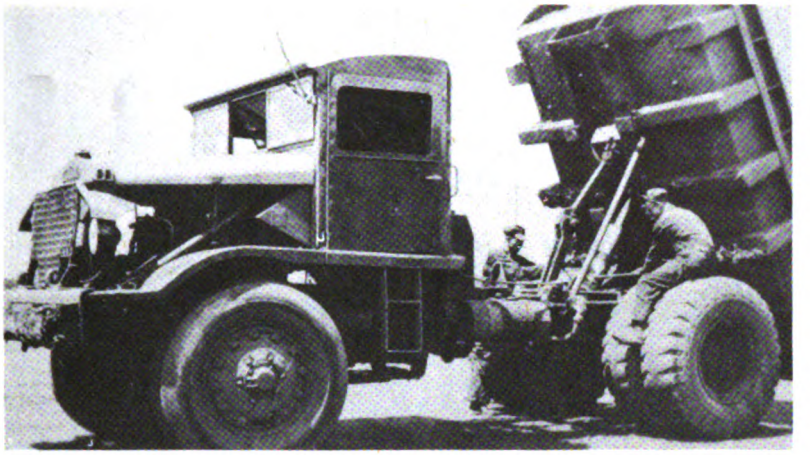


Figure 69. - Truck body safety block.

One of several methods of blocking truck bodies in a raised position when repair work is necessary. This bar or rod has an angle piece welded to the lower end, which seats on a cross member of the truck frame, and the top end seats in a natural socket or angle between the body bottom and its cross member. The body is raised, the rod put into place, and the weight of the body lowered onto the bar, making it impossible to accidentally fall and injure a repairman.

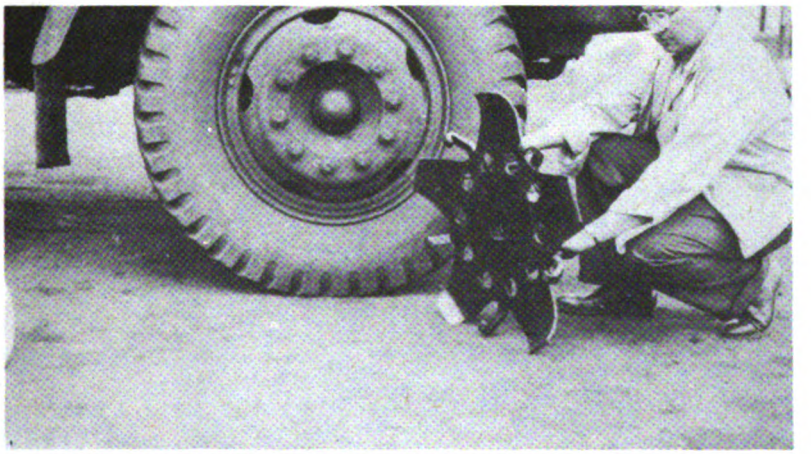


Figure 70. - Tire snap ring guard.

Serious injuries have been caused during the inflation of heavy truck tires by the snap ring flying off and a striking a repairman. This guard is made of aluminum, is light, easily handled, and clamps to the wheel by five movable fingers which fit into the wheel openings. The fingers are operated simultaneously by a lever on the back or outside.

Generated on 2024-09-19 19:13 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

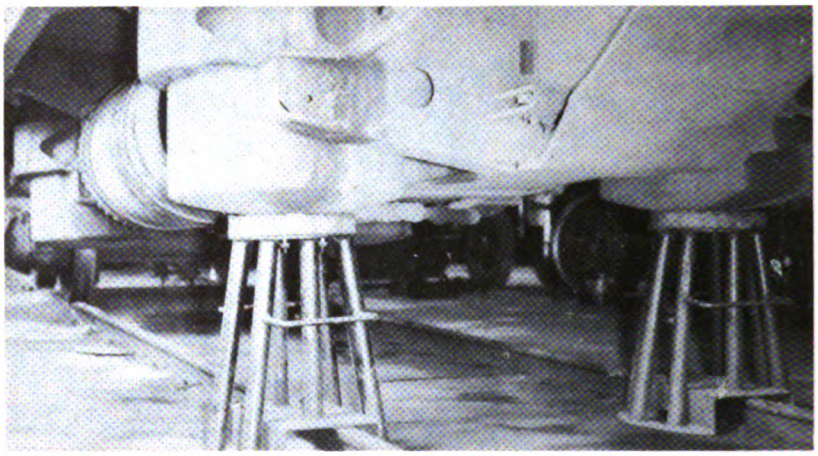


Figure 71. - Car support.

Pedestals or supports used in repairing dump cars. They are built of a steel bottom shaped to straddle the rail. The uprights are heavy pipe welded to the bottom and top plates. A 2-inch wood disc is bolted on the top plate. These replace the blocking frequently used for such work.

Figure 72. - Car door winder.

An electrically operated device used to wind up car doors after dumping. It is suspended from a roller operating on an overhead rail paralleling the track. This permits the winder to be easily moved from car to car.

Generated on 2024-09-19 19:11 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

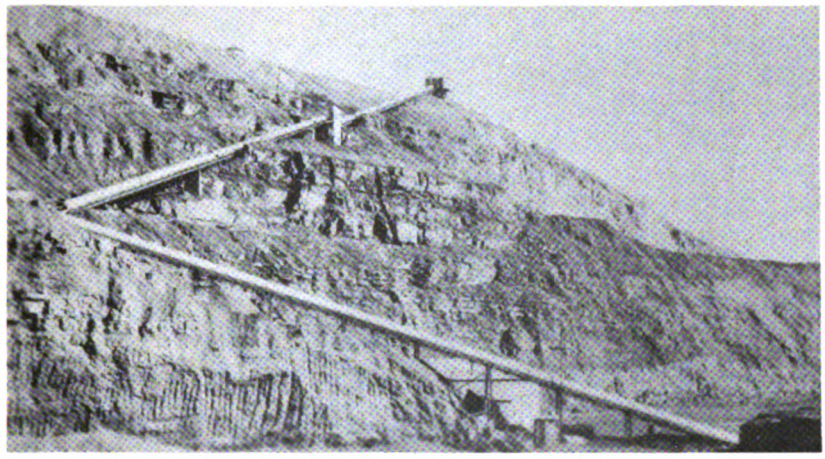


Figure 73. - Belt conveyor, open-cut mine

Originally, virtually all open-cut haulage was by rail. Later, in deepening the mines the grades became excessive and trucks were resorted to for haulage. Then, with further deepening, it became necessary to use trucks or scrapers in the pit and to elevate the material to the shipping pockets by conveyors. This is a covered belt conveyor used in an open-cut mine to transport the ore from a truck-dumping pocket in the pit to a car-loading pocket on the surface. This eliminates the hazardous and expensive practice of operating trucks on long, steep grades.

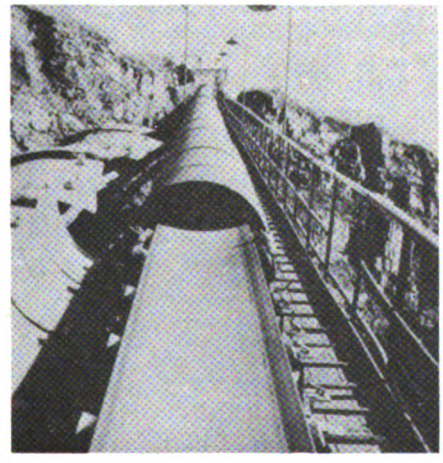


Figure 74. - Belt conveyor.

This is a section of the conveyor shown in figure 73. The belt is protected by arc sections of corrugated metal, which are hinged at one side and can be removed for greasing or repairs. The walkway along the conveyor is provided with cleats, a substantial railing, and overhead lighting. This facilitates accessibility and reduces the stumbling, slipping, and falling hazards to a minimum.

Generated on 2024-09-19 19:15 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

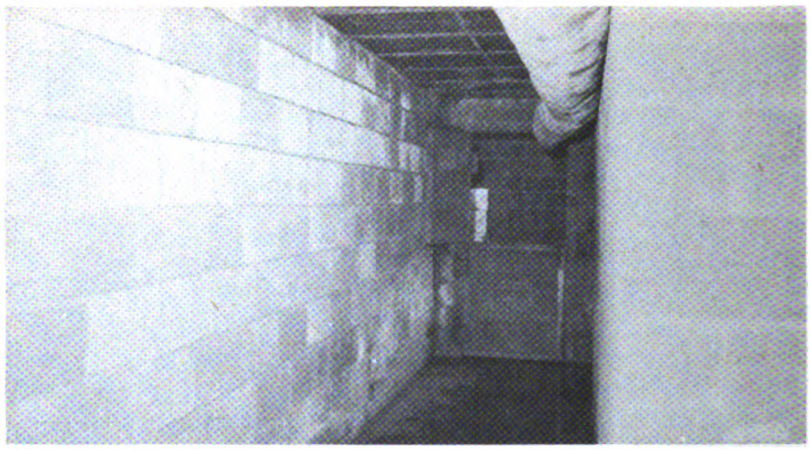


Figure 75. - Explosives-magazine entrance.

The location and arrangement of underground magazines in this district are generally good. The magazine, whose entrance is shown, is in a right-angled drift from the end of a crosscut off the main haulage drift. The drift is lined with cinder blocks, the floor is concrete, and steel members support the back. The magazine is ventilated through flexible tubing by a fan located in the main drift. Explosives are issued through the "Dutch" door, and only the keepers are allowed in the magazine.

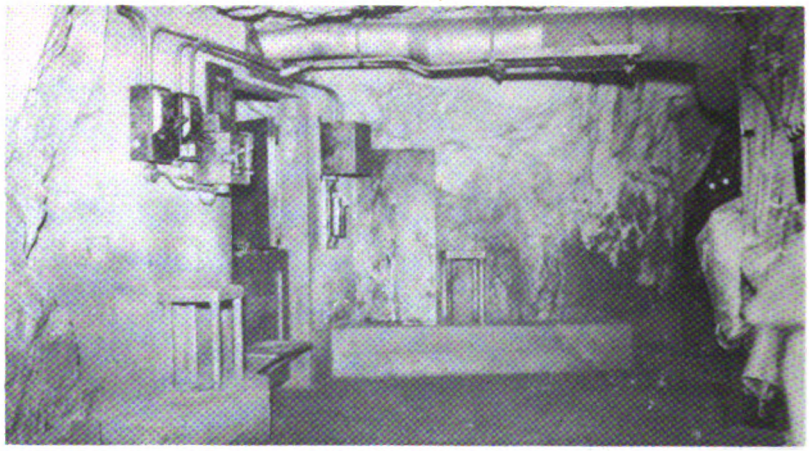


Figure 76. - Explosives-magazine entrance.

A concrete partition accommodates a "Dutch" door, the lower half of which serves as a counter for issuing the explosives. The small platforms or stools are used by the miners when adjusting the explosives-carrying cases on their backs. All electric switches are mounted outside, wiring is in conduit, and lights are of the closed type. The magazine is ventilated through a metal pipe by a fan located outside. The air is heated before it enters the magazine. To prevent overheating, the unit is thermostatically controlled.8/

8/ Cash, Frank E., Storage of Explosives in Underground Mines of the Lake Superior District: Bureau of Mines Inf. Circ. 7343, Feb. 1946, 9 pp.

Generated on 2024-09-19 19:14 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

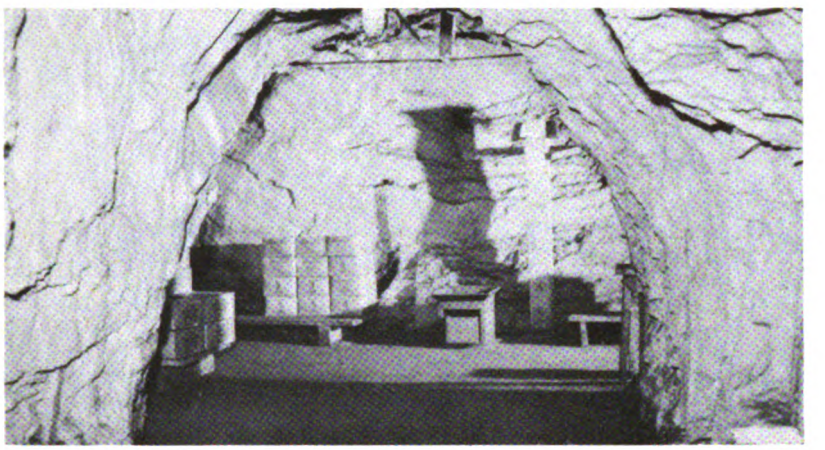


Figure 77. - Explosives—magazine interior.

An explosive magazine in a rock drift. The ventilation box, right rear, is connected to a 4-inch pipe laid in the concrete floor. The explosives cases are stacked four high on wooden platforms. The wiring is in conduit with explosion proof-type light fixtures.9/

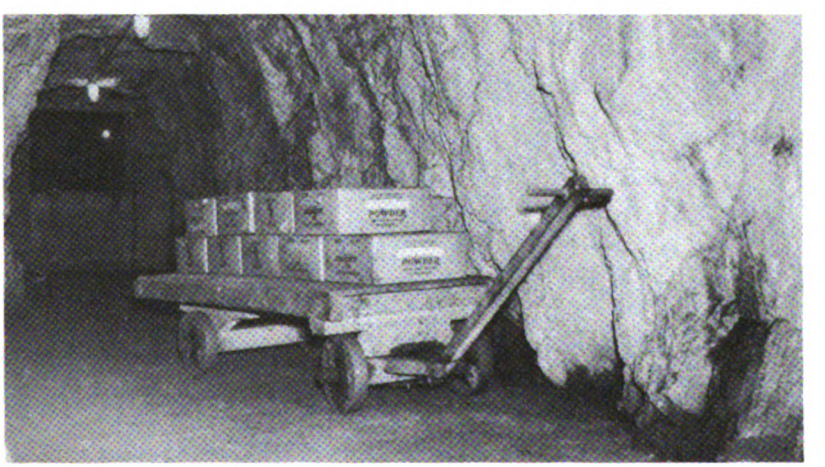


Figure 78. - All wood explosives truck.

The truck is used for handling cases of explosives from the explosives car into the magazine. It is constructed entirely of wood, with exception of the hinge pin attaching the front set of wheels. The entrance and magazine floor is concrete.10/

9/ See footnote 8.
10/ See footnote 8.

Generated on 2024-09-19 19:10 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Figure 79. - Preparing electric primers.

Interior view of a fuse and detonator magazine. The attendant is preparing electric primers. Each primer consists of a cartridge of explosives and an electric detonator placed within a cardboard tube, on which the ends are folded in. This protects the primer, especially if the hole is ragged. The primers are prepared at a central station, or magazine, for immediate use and are transported to the working place in the primer-carrying case shown in figure 80.11/

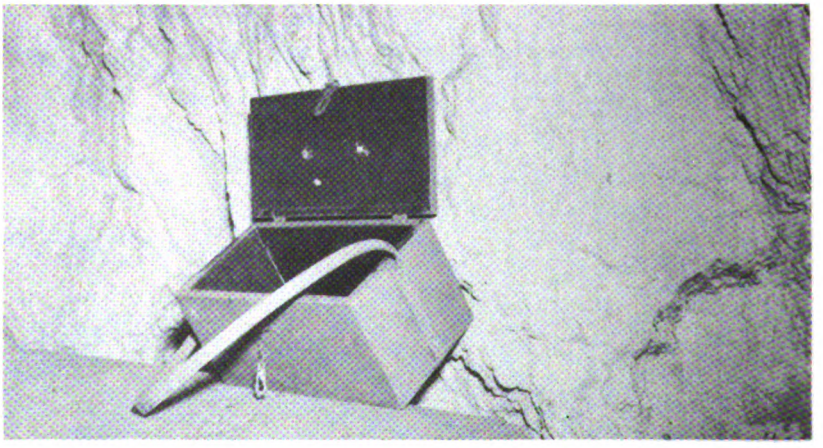


Figure 80. - Electric-primer carrying case.

Safe practice requires that explosives and detonators be kept apart until ready to load them into the blast holes; however, when conditions make it necessary to prepare the primers at a central and safer location some distance from the place of use, special care in handling is essential. This carrying case is constructed of wood and lined with felt. A hinged lid is secured with a hasp and snap, and a leather shoulder strap is provided for carrying.12/

11/ See footnote 8.
12/ See footnote 8.

Generated on 2024-09-19 19:10 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Figure 81. - Fuse cutting and capping station.

Most mines have fuse-cutting and capping stations 25 or more feet from underground explosives magazines. This station is timbered and lined with boards. The electric wiring is in conduit, the switch is on the outside, and the light fixtures are the vaporproof type. All fuses are cut, capped, and issued from this central station for the entire mine.

Figure 82. - Preparing clay stemming.

In some mines clay is sent underground and prepared in paper cartridges for use as stemming for explosive charges. In other mines the stemming cartridges are prepared on the surface.

Generated on 2024-09-19 19:10 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

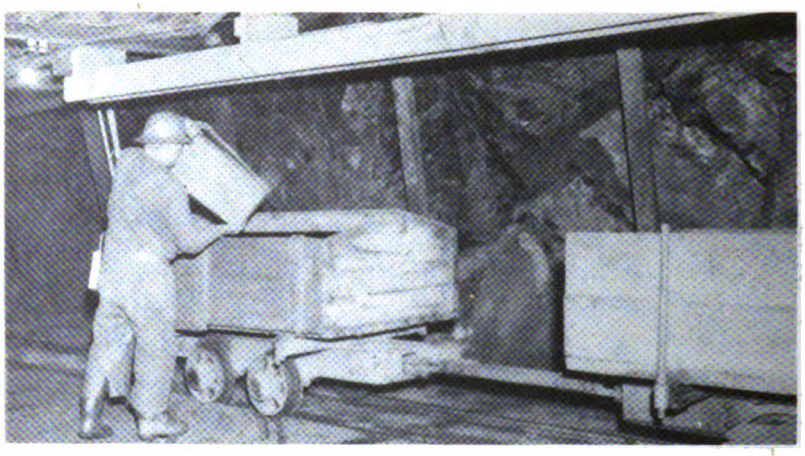


Figure 83. - Underground explosives car.

Car used for transporting explosives from the main underground magazine to the working places. The miner is shown placing a portable box-type magazine into the car. The explosives car is attached by means of an insulated coupling to an empty car, which is coupled to the locomotive.13/

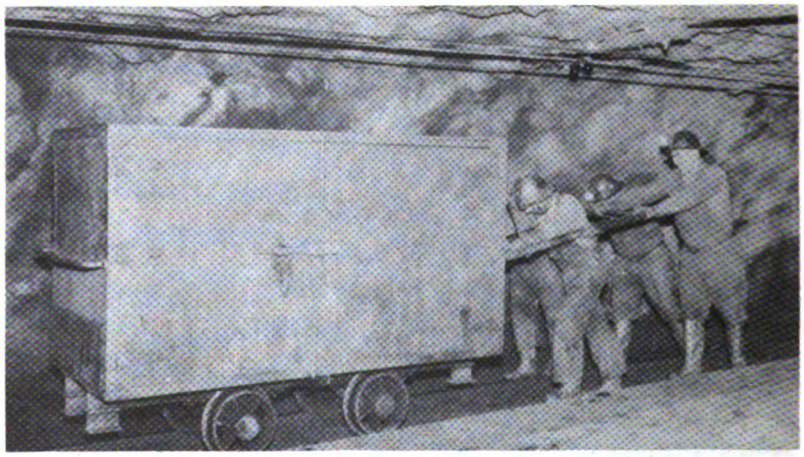


Figure 84. - Underground explosives car.

Car used for handling explosives on main levels. It is of steel wood-lined construction and has a capacity of fifty 50-pound cases of explosives. The car is designed to be pushed by hand, all power being cut off during the time that explosives are being handled.14/

13/ See footnote 8.
14/ See footnote 8.

Generated on 2024-09-19 19:20 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Figure 85. - Capped fuse carrying case.

Containers for carrying capped fuses from the surface to underground magazines or from underground magazines to working places are in general use in the district. This container holds a maximum of 100 8-foot capped fuses. It is made of metal, lined with felt, and the close-fitting lid is secured with a strap and buckle. A shoulder strap is provided for carrying purposes.

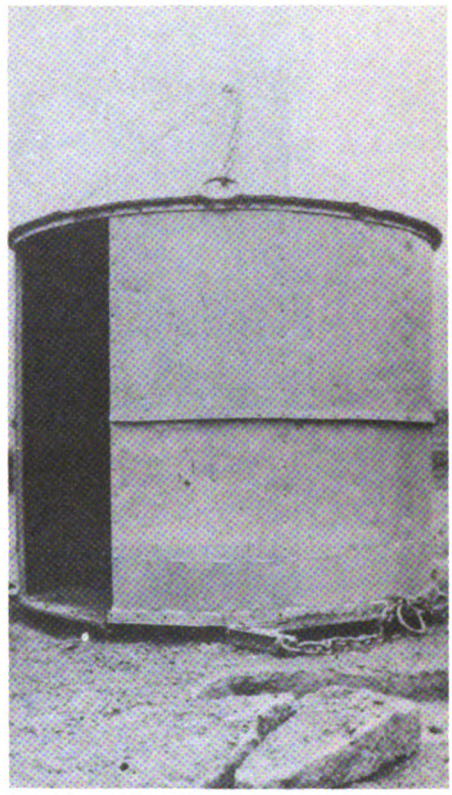
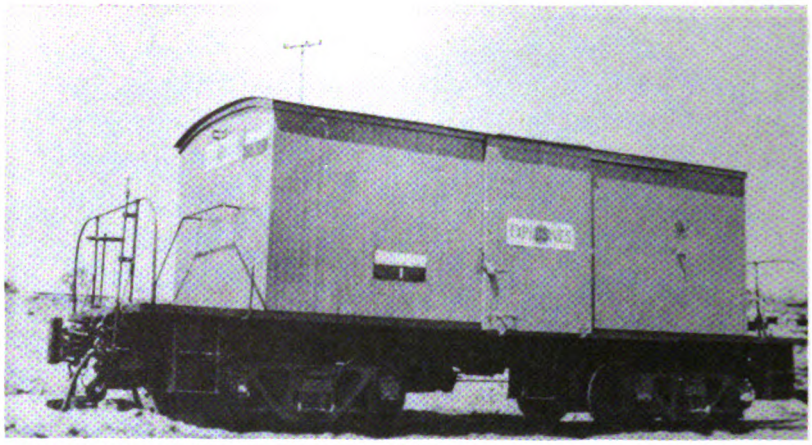


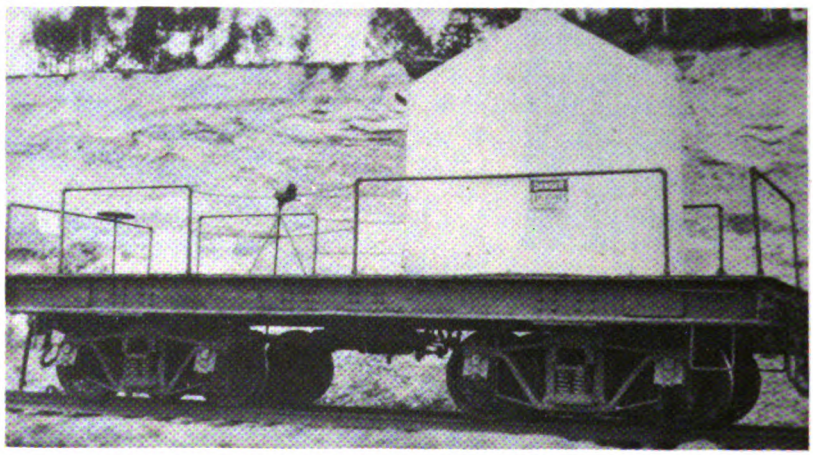
Figure 86. - Blasting shelter.

Circular steel shelter used to protect men during blasting operations in an open-cut mine. The chains and rings at the top and bottom are used when the shelter is moved vertically or horizontally from one location to another. The top chain is of sufficient length so that a man standing on the ground can engage the ring with the hook on a crane.

Generated on 2024-09-19 19:10 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY



A.



B.

Figure 87. - Open-cut explosives magazine.

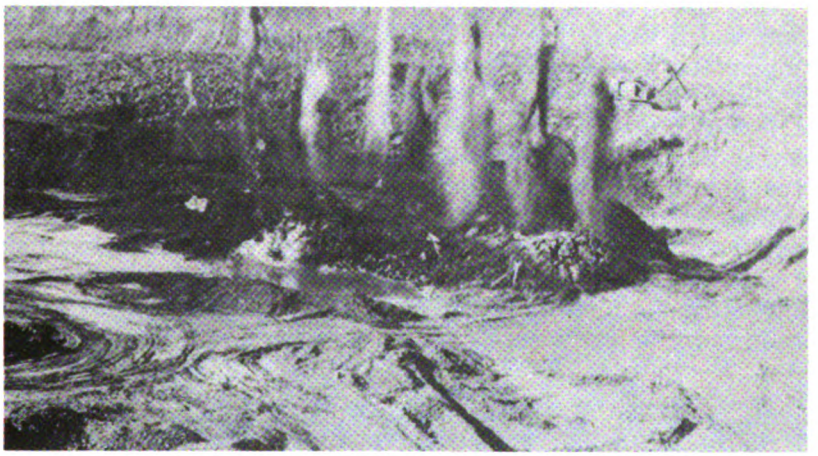
These explosives magazines are constructed in conformity with Interstate Commerce and Federal Explosives Act specifications. They are used to store and haul explosives to the blasting site and return to safe storage locations.

"A" is of steel and wood construction lined with wood. It is equipped with hand and standard air brakes, both of which can be applied from the platform.

"B" is of steel outside construction. It is lined with wood, leaving a 4-1/2-inch sand-filled space between steel and wood. The brakes are the same as on "A", and both cars have safety connecting chains in addition to the automatic couplings.

Generated on 2024-09-19 19:14 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

A.



B.

Figure 88. - Charging and blasting churn-drill holes.

"A" - The lower bench in this open-cut mine has been drilled with twenty 6-inch holes 25 feet deep. The holes have been charged with 1,900 pounds of gelatin dynamite, No. 6 electric detonators, and stemmed to the collar. Two men can be seen below the churn drill connecting the lead wires.

"B" - Blasting of round of holes described in "A". Note the geyser-like spouting of water and stemming material from the blast holes and the surge of water in front of the blasted area. The empty dynamite boxes shown at the left should have been broken up and burned to eliminate the possibility of explosives being overlooked. The shovel dipper is resting on the ground to prevent damage, as vibration might loosen the controls and let the dipper drop if it had been elevated.

Generated on 2024-09-19 19:11 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Figure 89. - Charging blast holes.

The practice to charge churn-drill blast holes by dropping the cartridges of explosives may be safe in shallow holes with smooth walls, where the cartridges fit tightly enough for air pressure beneath to retard their fall. A safer practice is to lower the explosives with a rope. The windlass is made from a 50-gallon steel drum on a tripod of 2-inch pipe. Cartridges of explosives weighing 50 pounds are lowered into the hole by attaching a hook on the end of the rope to a string bail on the cartridge. When the cartridge is in its position in the hole, the bail is broken by a quick jerk of the lowering rope. Advantages of lowering explosives are: (1) less chance of cartridge lodging in hole, (2) less chance of damaging the detonating fuse or electric detonator wires, and (3) more remote possibilities of an accidental detonation.

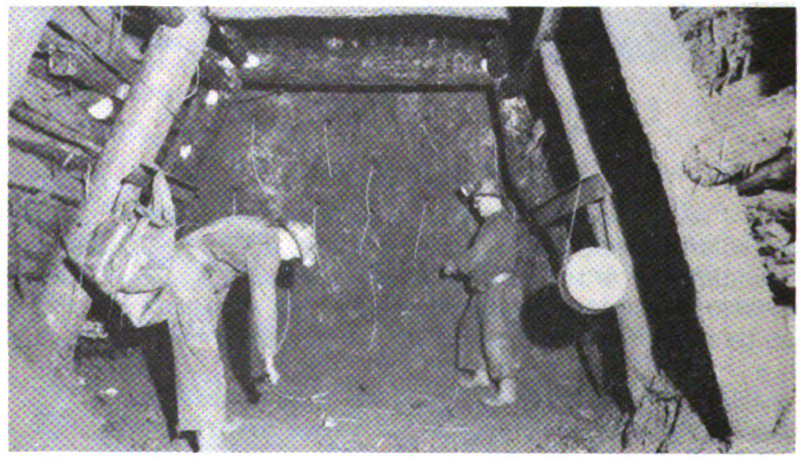


Figure 90. - Charging blast holes.

Charging operation of a 20-hole blast round underground. Capped fuses are carried to the blasting in a circular felt-lined metal container which can be seen hanging on the right side. Explosives are carried in the rubberized canvas bag at the left.

Generated on 2024-09-19 19:11 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

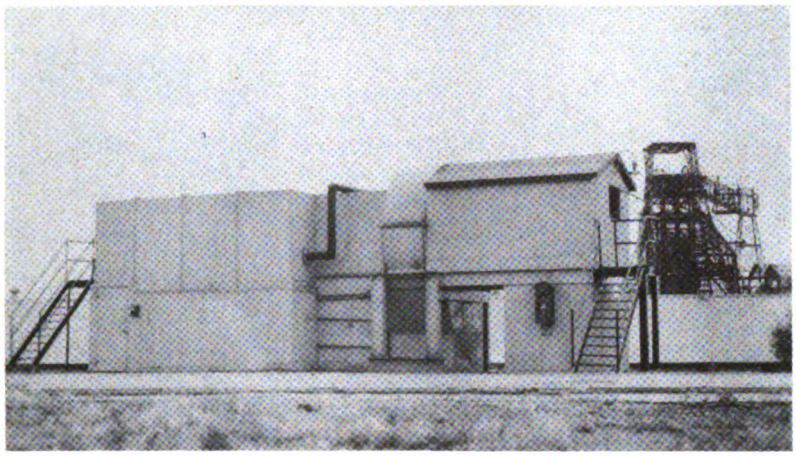


Figure 91. - Fan installation - surface.

Ventilation plant for an underground mine. The air is forced by the fan down an incline that connects with the downcast shaft, the headframe of which can be seen in the background. During cold weather the air is heated by steam coils to prevent ice from forming in the shaft and to give comfortable working temperatures underground.

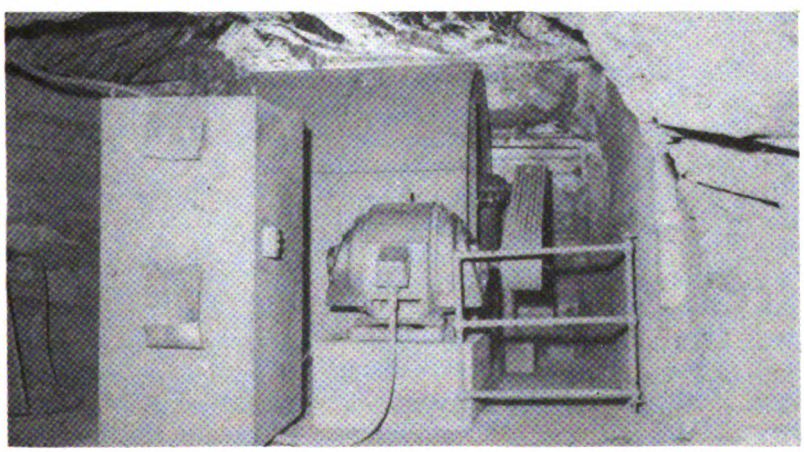


Figure 92. - Fan installation - underground.

This fan installation, although underground, is in a rock drift with concrete-faced walls. The fan is a No. 9 high-speed centrifugal-type with a rated capacity of 90,000 cubic feet of air a minute at a 6-inch water-gage pressure. The fan is driven through V belts by a 100-horsepower, 2,200-volt, alternating-current, enclosed motor. The enclosed controls at the left are arranged so that the fan can be stopped from the surface and started and stopped at the fan location.

Generated on 2024-09-19 19:16 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

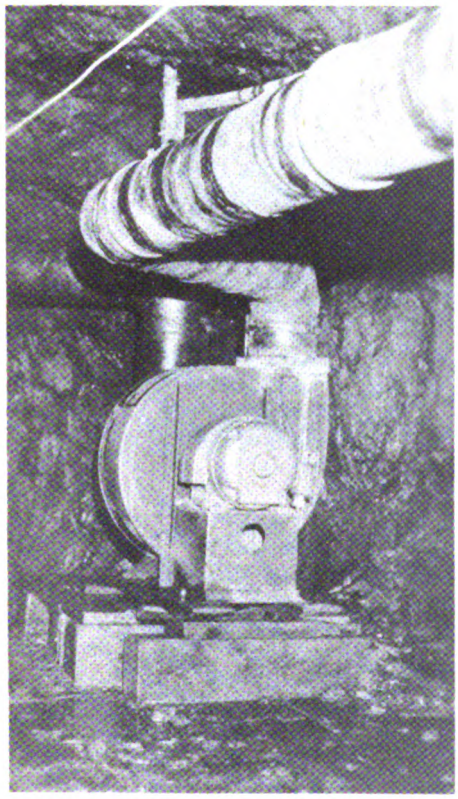


Figure 93. - Exhausting fan.

One important function of mine ventilation is the removal of dust and explosives fumes from the mine workings. This is frequently accomplished by exhausting the air through tubing or pipe to avoid exposure of workmen in the drifts to these possible hazards. This fan is driven by a 25-horsepower, 220-volt, alternating-current motor and has a rated capacity of 5,000 cubic feet a minute. It is exhausting from a long drift through 14-inch spiral-welded ventilation pipe. Although the first cost of this pipe is more than the usual type of flexible tubing or galvanized-iron ventilation pipe, the extra cost is justified by its air-tightness and ease in reclaiming or re-erecting without damage.

Figure 94. - Ventilation door.

This ventilation door is commercially available and is mechanically operated by the haulage train. It is hinged on both sides; one side opening against the air pressure, and the other side with it. The door is fully automatic; it is opened by the weight of the locomotive or cars on a third rail which is engaged by the flanges of the wheels as the train approaches the door. The doors are painted a distinctive color or pattern in order to make them easily visible from an approaching train. Man-travel is through an adjacent two-door air lock.

Generated on 2024-09-19 19:10 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Figure 95. - Ventilation door.

Ventilation door operated by a compressed-air cylinder. It is a two-door arrangement in which the doors swing in opposite directions and is operated by the motorman, who is required to bring the train to a full stop. The door is opened or closed by operating a lever attached by wire cables to a three-way valve on the compressed-air cylinder. On pushed trips in the mine where this picture was taken, the brakeman precedes the train on foot and operates the doors. The doors in other mines are operated from the train, traveling in either direction, by the more remote location of the operating lever.

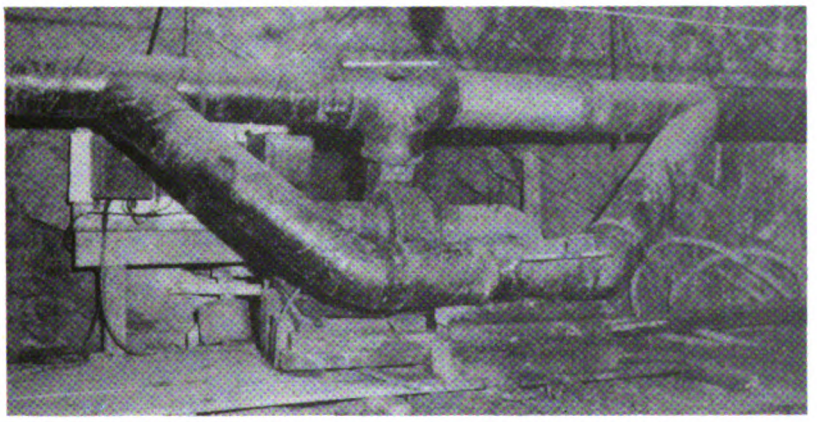


Figure 96. - Two-fan reversible unit.

An arrangement using two high-speed, high-pressure fans in series to ventilate a long development heading through 16-inch ventilation pipe. The unit can be reversed and used to exhaust the smoke and gases after blasting by the manipulation of the two sets of tandem valves. When used blowing, air enters from the right-hand pipe, down the inclined section, thence through the two fans, which force the air up to the tee in the center and through the left-hand pipe to the face. To use the unit exhausting, the operation of the valve is reversed.

Generated on 2024-09-19 19:11 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Figure 97. - Ventilation door.

Metal ventilation-control door set in a concrete stopping or bulkhead. The top of an air raise is visible at the left. A sign at the right points to an emergency escape or ladderway to the surface. Good housekeeping is in evidence.

Figure 98. - Air raise.

Air raises are an adjunct to proper ventilation in metal mines. Ladders are essential to raise travel. Sollars are safeguards against men falling. The combination of air raise, ladder, and metal grill sollar allows free passage of air with maximum protection in the raise to the traveler.

Generated on 2024-09-19 19:12 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Figure 99. - Sealing worked-out areas.

The stopping is being erected to seal off an abandoned stope area. The walls of the stopes contain black slate, which has sufficient sulfides and carbonaceous material to cause spontaneous combustion if exposed by caving. The stopping is constructed of shiplap on 2- x 4-inch studding, over which expanded metal lath is secured. The stopping is then plastered with wood fiber.

Figure 100. - Mine rescue training.

Mine rescue crew training underground. The men are equipped with 2-hour, self-contained, oxygen breathing apparatus and are wearing hard hats, electric cap lamps, and gastight goggles.

Generated on 2024-09-19 19:10 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

A.

B.

Figure 101. - Life-line-telephone assembly.

This mine rescue life-line-telephone assembly is used in rescue and recovery operations during mine fires or similar emergencies. As the name implies, the equipment provides for safer travel and for two-way telephone conversation as well as buzzer-signal communication between the fresh-air base and the traveling mine rescue crew. It consists of a 1,000-foot, three-conductor, rubber-covered cable mounted on a reel, which has three collector rings that provide connections to an instrument box. The instrument box contains six standard dry cells, buzzer, spark coil, return-call push button, and a French-type hand-telephone set with a built-in push button to complete the circuit for telephone conversation. The advance crew carries a similar hand-telephone set connected to the life-line-cable. The push buttons are used for signaling. Telephone conversation is accomplished by pressing the button on the fresh-air base telephone, which completes the circuit through the batteries and both telephones.

"A" shows the rescue crew holding to the life line or cable at proper intervals. The captain or No. 1 man is carrying the telephone.

"B" shows the equipment as it would be set up at the fresh-air base. This type of equipment greatly facilitates and speeds rescue and recovery work with greater safety to the crew. The equipment is suitable for use in metal or other mines where explosive gas is not likely to be encountered.15/

15/ Forbes, J. J., Griffith, F. E., Cash, F. E., and Petersen, M. S., Mine Rescue Life-Line Assemblies: Bureau of Mines Report of Investigations 3875, March 1946, 11 pp.

Generated on 2024-09-19 19:18 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Figure 102. - Fire maps.

The fire-map case is in a conspicuous place on the wall of the mine captain's office. It contains pertinent information relative to handling possible fires, such as a surface map showing the location of fire hydrants, hose, and extinguishers; an underground map showing the mine workings and ventilation; and a list of mine rescue-trained men with their telephone numbers.

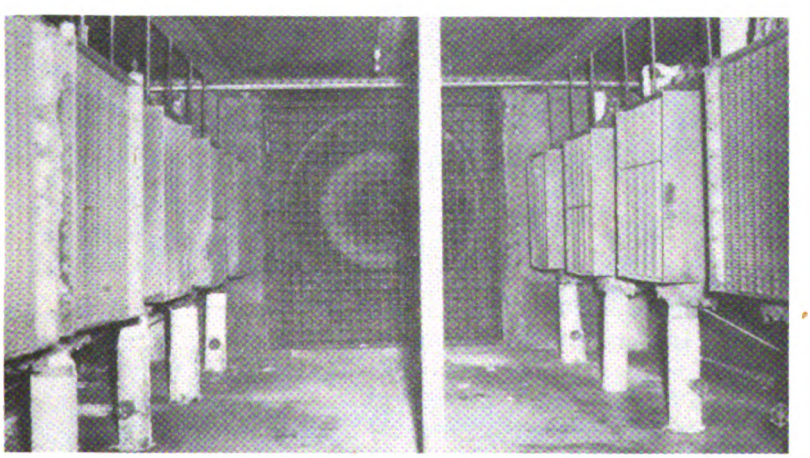


Figure 103. - Air-heating units.

Ten unit heaters installed on the intake side of the main fan supplying air to an underground mine. They are grid-type, heated by steam, and are equipped with individual fans. Their purpose is to heat the mine intake air sufficiently to prevent ice from forming in the hoisting shaft and to provide comfortable working temperatures. The total capacity is sufficient to raise the temperature of 35,000 c.f.m. from -30° F. to above the freezing point.

Generated on 2024-09-19 19:12 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

A.

B.

Figure 104. - Mine rescue station.

Interior view of a central mine rescue station. The station and equipment serve several mines in a radius of 10 miles. Complete facilities for classroom instruction and practice in the use of the equipment are provided. An ample supply of cardoxide, oxygen, and spare parts is maintained. In addition, brattice cloth, fog nozzles, and other emergency supplies are kept on hand in the station.

"A" - Pump, apparatus, bench, blackboard, table, and chairs.

"B" - Blackboard, table, chairs, cardoxide, sink, workbench, and accessories.

Generated on 2024-09-19 19:13 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

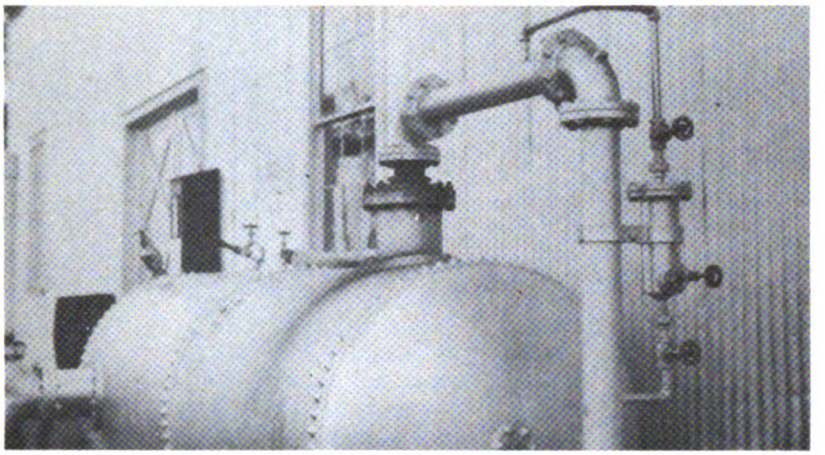


Figure 105. - Stench injector.

This and other types of stench injectors are described in detail in Report of Investigations 3850. This injector is installed on the compressed-air system of an underground mine and is used as a method of warning men in the event of a mine fire or other emergency. The injector (at the right) contains a sealed bottle of ethyl mercaptan, which can be broken by screwing down the valve stem attached to the body of the injector. Opening the valves at the top and bottom of the injector allows the liquid to enter the air line, where it is vaporized and carried into the mine workings.

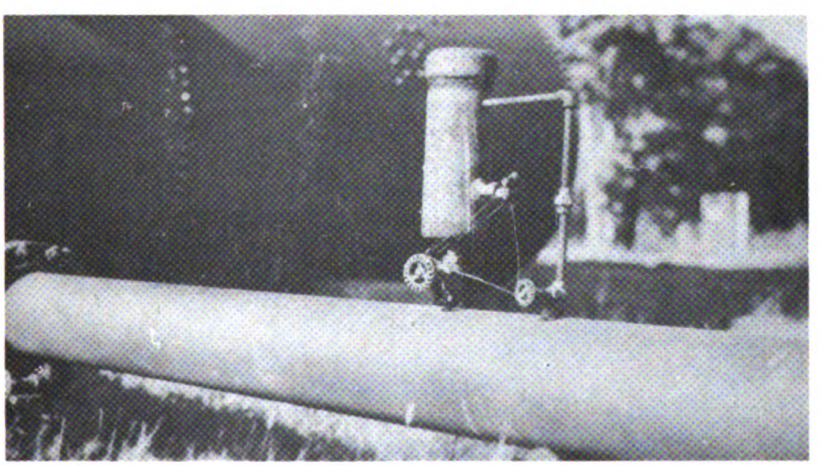


Figure 106. - Stench injector.

Injector installed on a horizontal air line. The device is similar to figure 105, except that the valves are sealed with a wire and lead seal to indicate whether there has been any tampering.16/

16/ Cash, F. E., and Johnson, Ernest W., Stench-Warning Tests, Lake Superior District Mines: Bureau of Mines Report of Investigations 3850, November 1945, 23 pp.

Generated on 2024-09-19 19:13 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

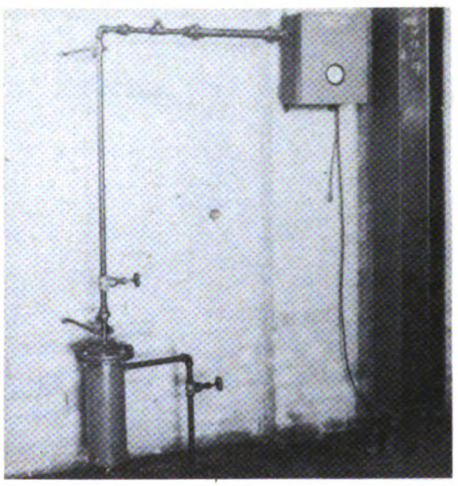


Figure 107. - Carbon-monoxide alarm.

This carbon-monoxide alarm, connected to the compressed-air system on the surface, provides for the continuous sampling of the compressed air delivered to the underground workings. If the concentration of carbon monoxide is above 0.02 percent, the alarm sounds in the compressor room. This enables the attendant to stop the compressor and prevent the poisonous gas from entering the mine and affecting the workmen. Such a condition might arise from overheating of the compressor or an oil fire in the receiver.

Figure 108. - Carbon-monoxide alarm.

Carbon-monoxide alarm installed in a return-air drift, which passed a sealed fire area. The device provides continuous sampling of the passing air and is so set that if the carbon monoxide concentration in the air reaches 0.02 percent, a warning is given by a red light and bell.

Generated on 2024-09-19 19:13 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Figure 109. - Fire extinguisher.

Nonfreezing type fire extinguisher in a cabinet near a door on the outside of a warehouse. There are fire extinguishers inside the building, but this provides fire protection to inside storage from without.

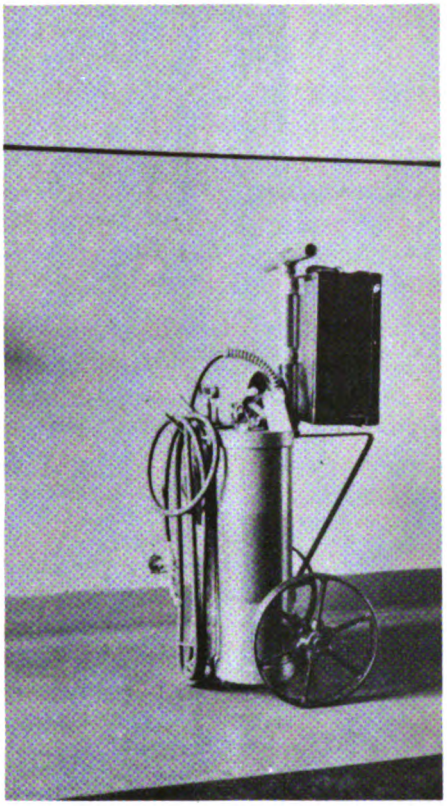


Figure 110. - Fire extinguisher and gas mask unit.

Portable fire-extinguisher unit. The gas mask, in its case, is attached to the handle of the unit, and the 3-1/2-gallon extinguisher is mounted between the wheels. The gas mask is provided for the use of the extinguisher operator in case of use in confined or unventilated places, where contact of the extinguisher liquid with hot objects might cause dangerous concentrations of toxic gases.

Generated on 2024-09-19 19:16 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

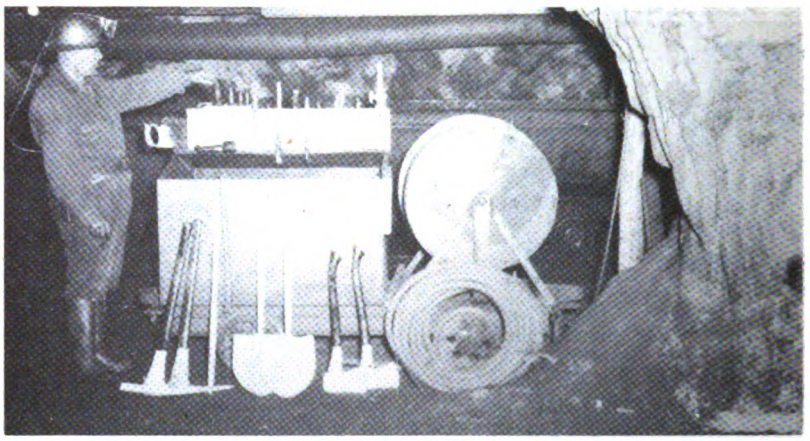


Figure 111. - Emergency fire truck.

Emergency fire truck for use in combatting incipient fires underground. The truck operates on mine track and is small enough to be transported on the cage from one level to another. The reel holds 250 feet of 1-1/2-inch water hose, and 50 feet of 3/4-inch hose is carried in the tool box. The miscellaneous tools shown are painted white to distinguish them from the regularly used mine tools and to prevent their use for other than their intended purpose. The saws are stored in a separate box, to which a drying agent has been added to prevent rusting.

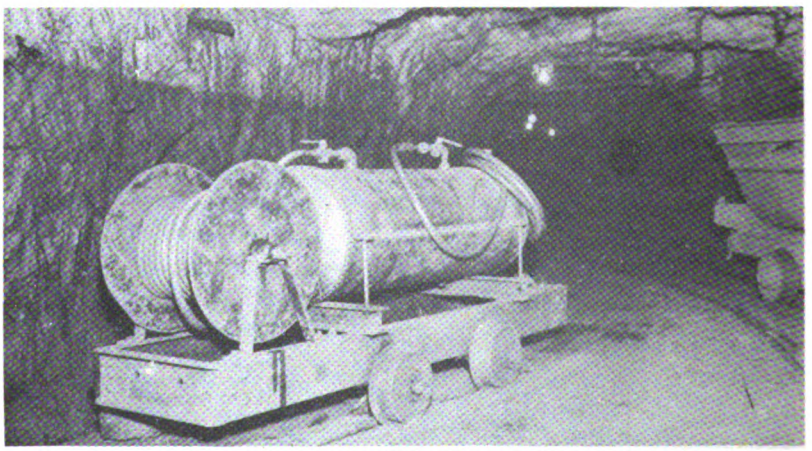


Figure 112. - Underground fire truck.

Fire truck provided for emergency use in fighting incipient mine fires at locations where a regular water supply is not available or in the event of a failure of the regular water supply. The tank has a capacity of 200 gallons, is a pressure-type, and utilizes the regular mine compressed-air supply. The reel accommodates 100 feet of water hose the same size as standard air hose. This permits additional lengths if necessary. The unit is track-mounted and can be handled from level to level on the cage.

Generated on 2024-09-19 19:10 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

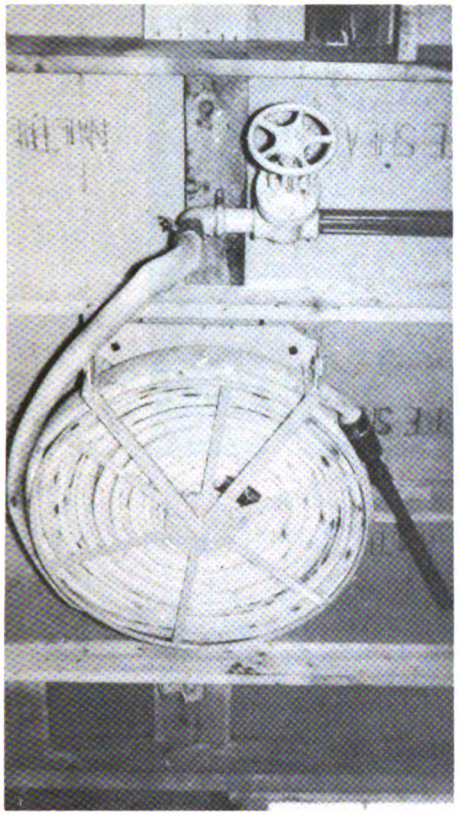


Figure 113. - Fire hose.

A 100-foot length of fire hose is mounted on a reel inside a shop building. The hose has a nozzle on one end, and the other end is attached to a 2-inch standpipe. The hose is so reeled that it can be unreeled by simply pulling on the nozzle. A drain cock is provided on the standpipe elbow below the valve to prevent water from rotting the hose.

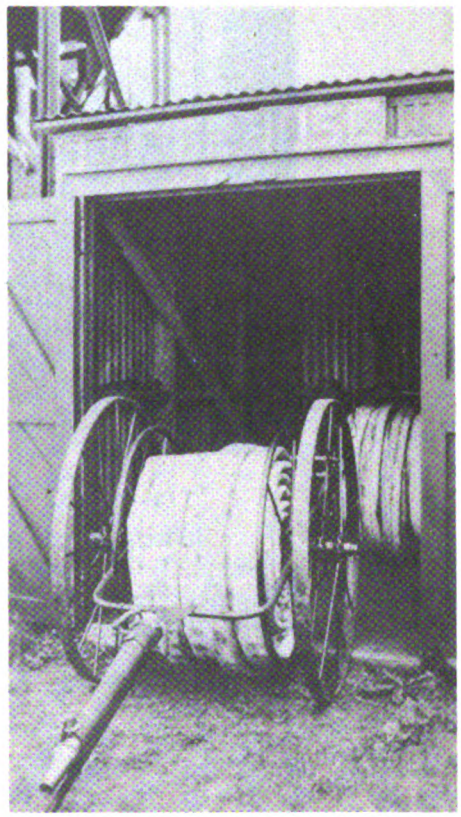


Figure 114. - Hose carts.

Two hand-pulled carts containing standard fire hose on reels, together with nozzles and tools. These are for use by employees to combat a fire before the regular fire department arrives.

Generated on 2024-09-19 19:10 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

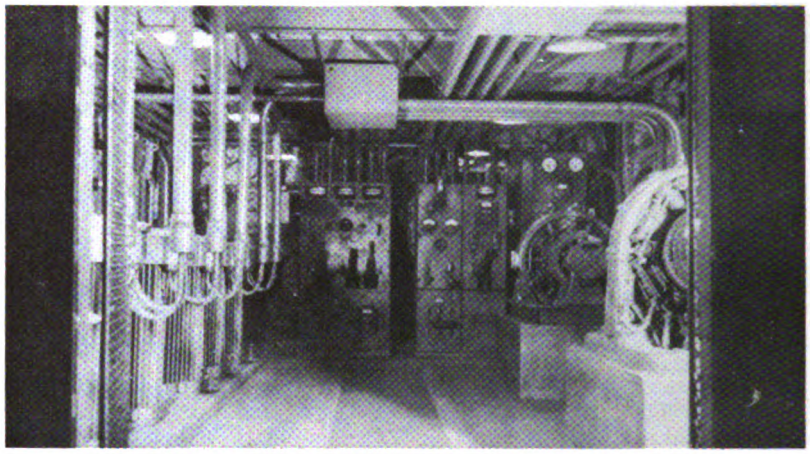


Figure 115. - Transformer-converter station.

Underground transformer-converter station. It is a compact, well-arranged installation with all energized equipment insulated or isolated. The room is concrete and steel. The doors are locked against entrance by unauthorized persons.

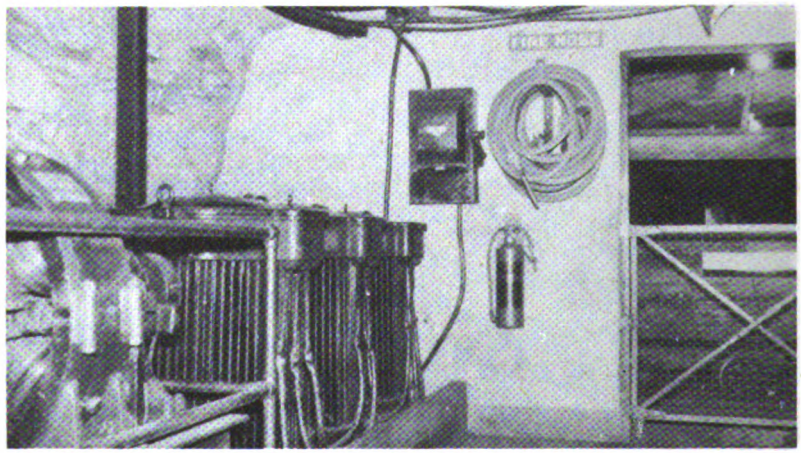


Figure 116. - Transformer station.

Transformer station in an underground pumproom. A concrete curb around the base of the transformers is to confine the oil in the event of a ruptured transformer case. Fire hose and a fire extinguisher are conveniently mounted near the door.

Generated on 2024-09-19 19:14 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

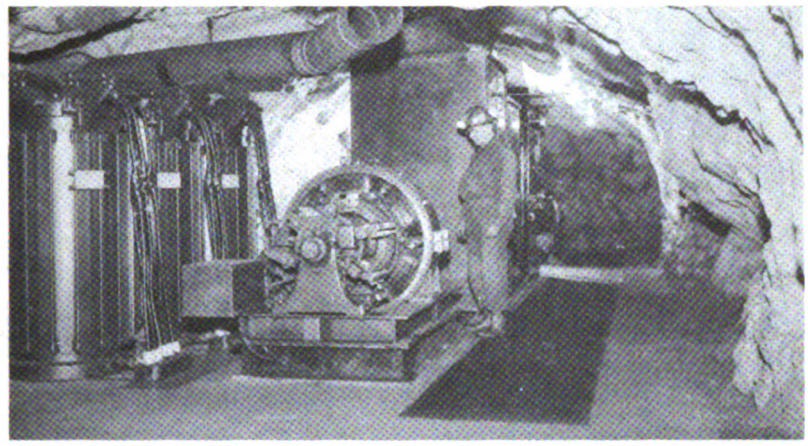


Figure 117. - Converter station.

Underground transforming-generating station. The room is cut in solid rock, which does not require support; however, the sides and back are gunited to prevent slacking and spalling. The floor is concrete. Note the ventilation pipe over the generator near the back and the rubber mat on the floor in front of the generator and switch panel.

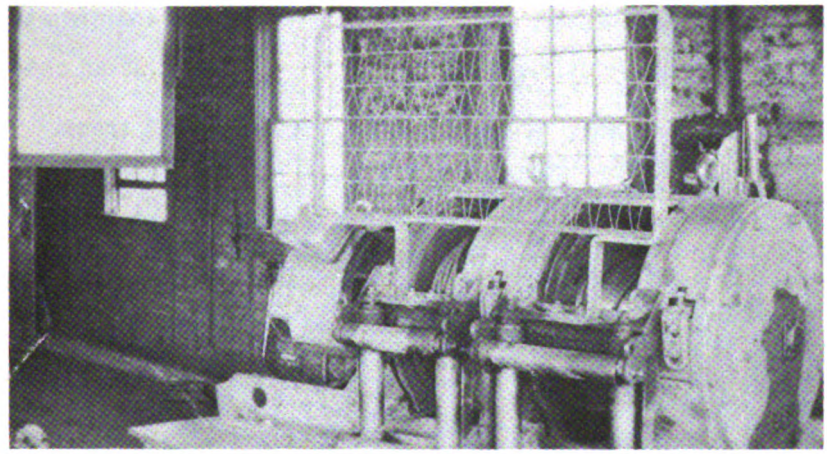


Figure 118. - Tugger hoist.

Guard erected in front of a tugger hoist used to move a coal scraper in a power plant. The guard prevents injury to the operator from a backlash in the event of a broken cable.

Generated on 2024-09-19 19:14 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

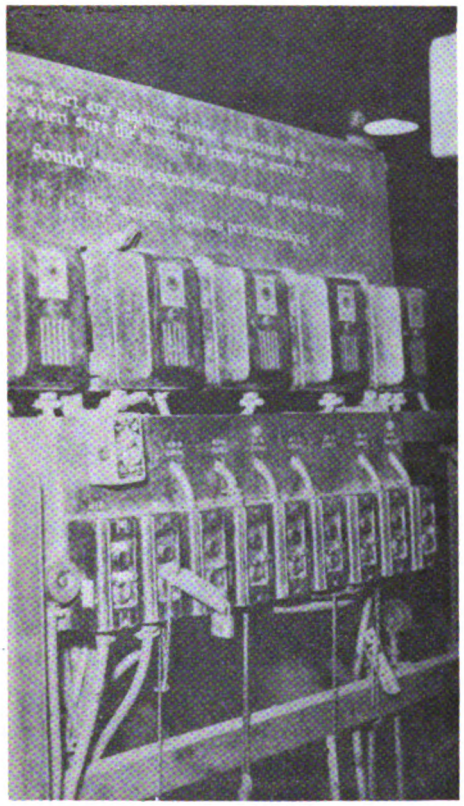


Figure 119. - Starting switches.

Method of locking electric starting switches in the "off" position during repair work on the equipment. A locking clamp (shown on second switch from the left) permits from one to five locks to be attached. Thus, if more than one person is engaged in repair work on the equipment, each has a lock on the switch and the switch cannot be closed and the equipment started until all locks are removed.

Figure 120. - Interbonding.

Electrician checking the interbonding of air-line, water-line, and haulage track. The multiple bonding results in improved return and reduces the hazards of stray currents to a minimum. Poor or inadequate bonding not only results in excessive maintenance costs on electrical equipment, but many explosives accidents have been attributed to the same cause.

Generated on 2024-09-19 19:15 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

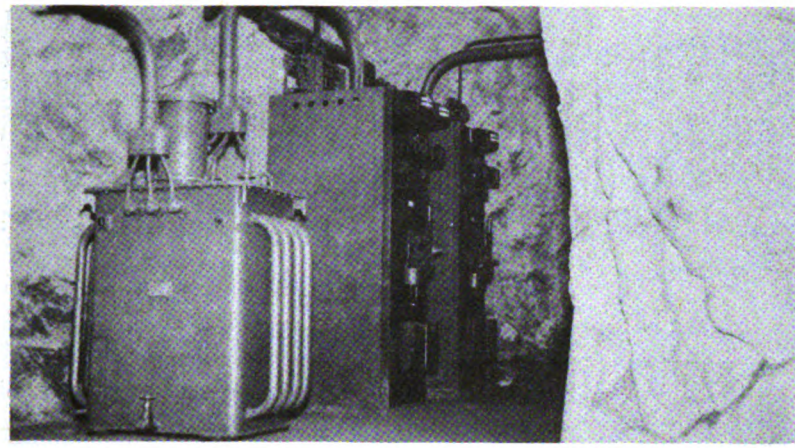


Figure 121. - Transformer station.

Underground transformer station in a recess cut in the rock. The installation is isolated and fireproof.

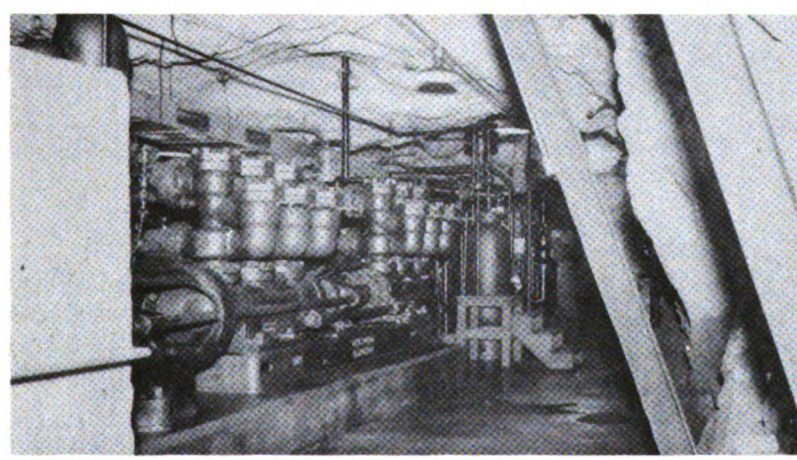


Figure 122. - Pumproom underground.

This pumproom is cut in rock. The sides and back are gunited, and the floor is concrete. The tapered box-type metal duct over the pumps provides adequate ventilation.

Generated on 2024-09-19 19:10 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Figure 123. - Electric cable support.

Electric-cable support over roadways in an open-cut mine. The uprights are metal pipes with circular or square metal bases. The cross member is wood with rounded shoulders.

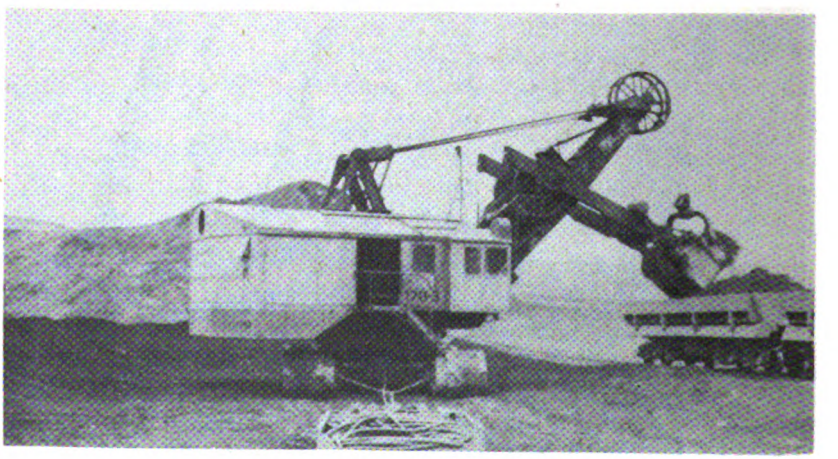


Figure 124. - Cable boat.

This is known as a "cable boat" and is used to carry and protect the excess power cable leading to an electric shovel. The boat is constructed of metal and is attached to the shovel by chains. As the shovel advances, the boat slides behind it and the cable is played out.

Generated on 2024-09-19 19:10 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

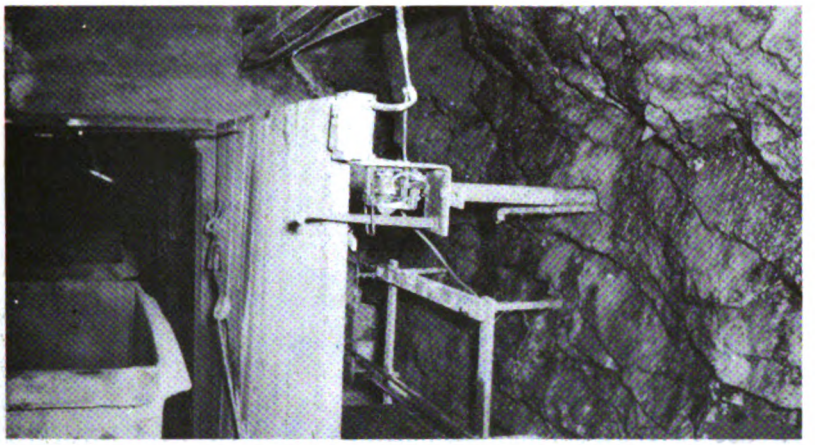


Figure 125. - Solenoid-controlled door hook.

The ventilation door shown here is operated by a compressed-air cylinder controlled by a solenoid valve. In the event of an interruption of the electric power, the door would close and could cause a wreck if a train were passing through. To remove or eliminate this hazard, a safety hook is provided which drops and holds the door open should the power fail.

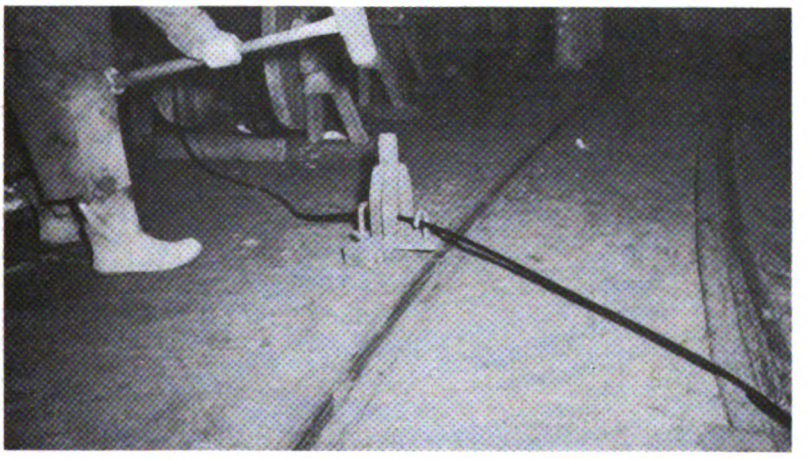


Figure 126. - Cable cutter.

Cable-cutting device used to cut off suitable lengths of wire rope for various uses. It consists of a metal base with a slot in which the cable is placed. A chisel is held in place over the cable with guides, and the cable is cut by striking the head of the chisel with a sledge hammer.

Generated on 2024-09-19 19:15 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

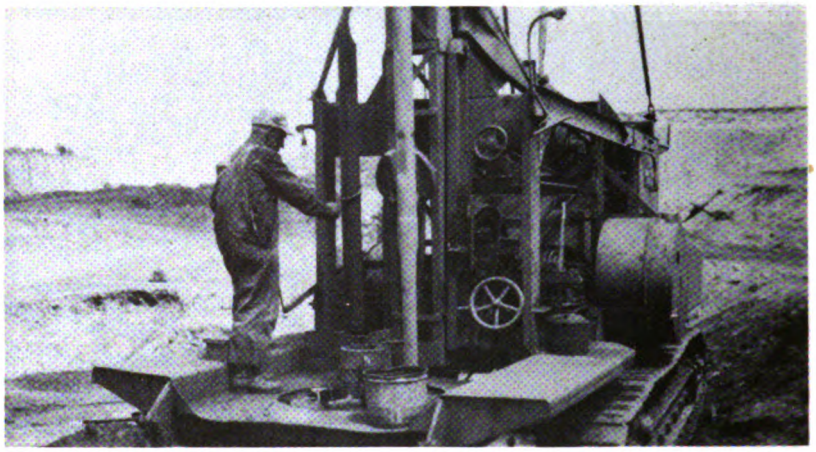


Figure 127. - Mud bailer hook.

S-shaped hook used to guide the mud bailer to the dumping position in churn-drilling operations. After placing the hook around the bailer, it is tightened by a slight downward push. This gives the operator a secure grip on the bailer, reducing injuries caused by the hands slipping off the wet, muddy bailer.

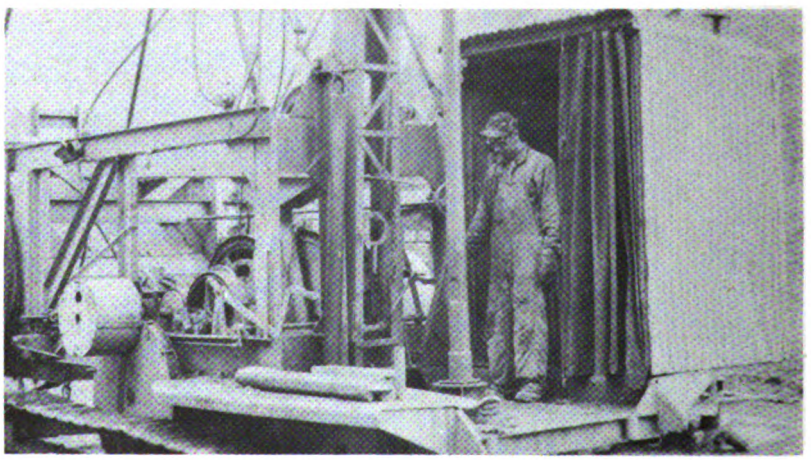


Figure 128. - Shelter on churn drill.

Shelter built on the platform of a churn drill. It protects the operator from severe weather conditions and assures his being close to the operating equipment.

Generated on 2024-09-19 19:12 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

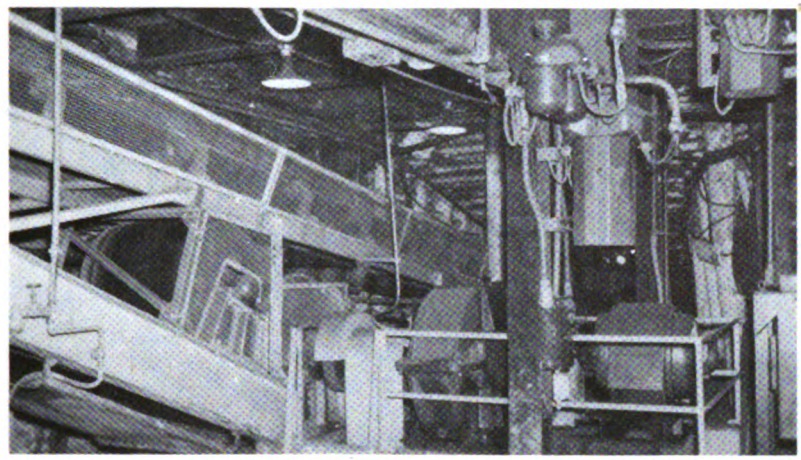


Figure 129. - Belt-conveyor guards.

Guarding at a transfer-and-drive station of an underground belt conveyor. The motor and gear-reduction unit at the lower right is enclosed by a railing guard. The ends of the head and tail pulleys of the belt are covered by screen guards. A screen guard is also installed along the side of the belt where there is a hazard to employees from material falling off the belt.

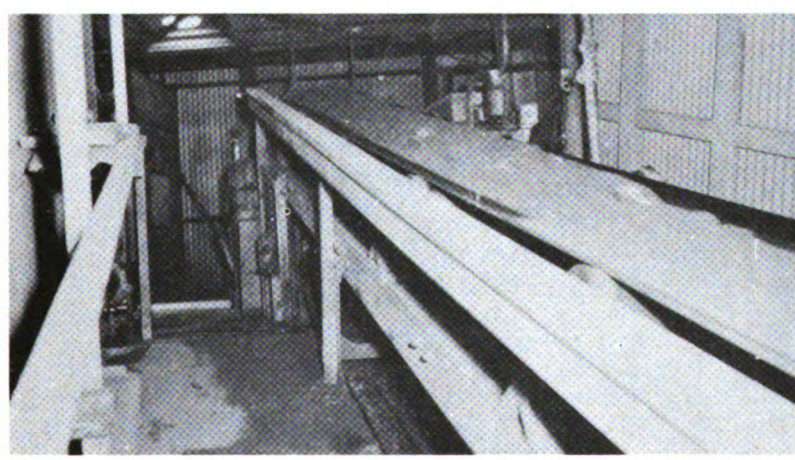


Figure 130. - Guardrail on belt conveyor.

Surface installation showing a belt conveyor with a guardrail to prevent accidental contact with the belt idlers.

Generated on 2024-09-19 19:10 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

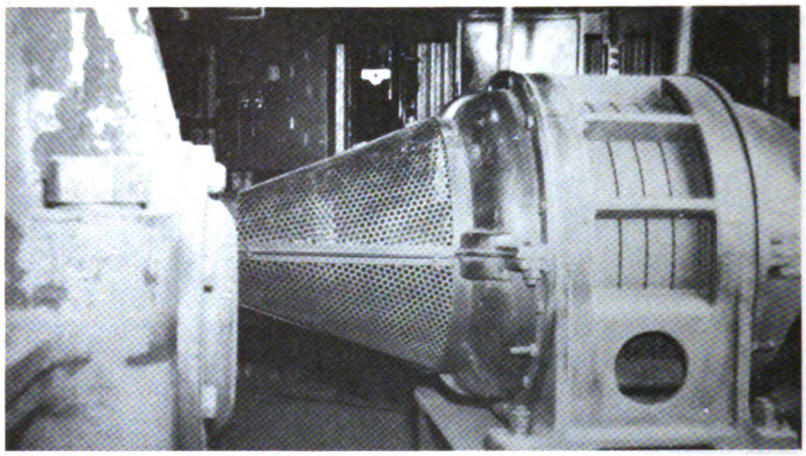


Figure 131. - Motor-coupling guard.

This guard covers the open end of the motor and completely encloses the motor shaft and coupling. It is made in four sections of perforated metal, the holes of which are small enough to prevent the entry of a finger.

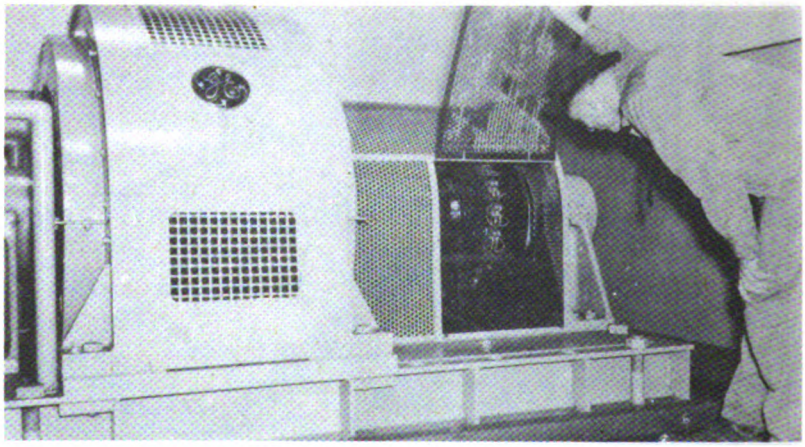


Figure 132. - Motor guard.

Perforated metal guard completely enclosing the slip-ring end of a hoist motor. Hinged sections on both sides allow easy access for inspection, adjustment, or repair of the equipment.

Generated on 2024-09-19 19:10 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

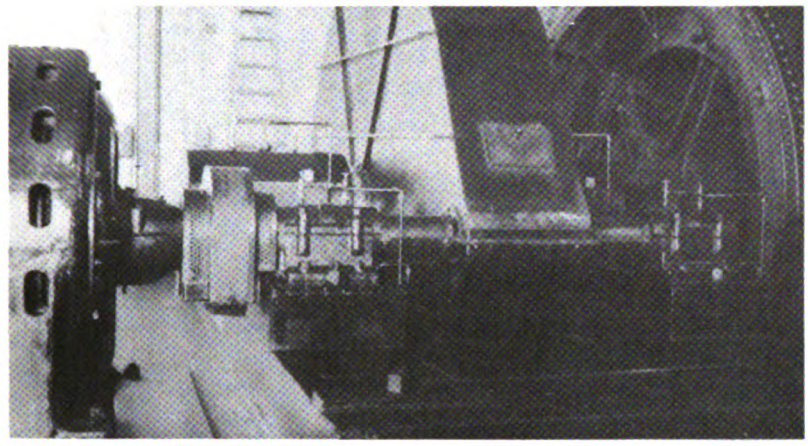


Figure 133. - Coupling and gear guard.

An adequately guarded shaft and flexible coupling. The coupling is entirely enclosed, and the shaft is covered by a perforated metal guard. The gears to the hoist driver are enclosed by a solid metal guard.

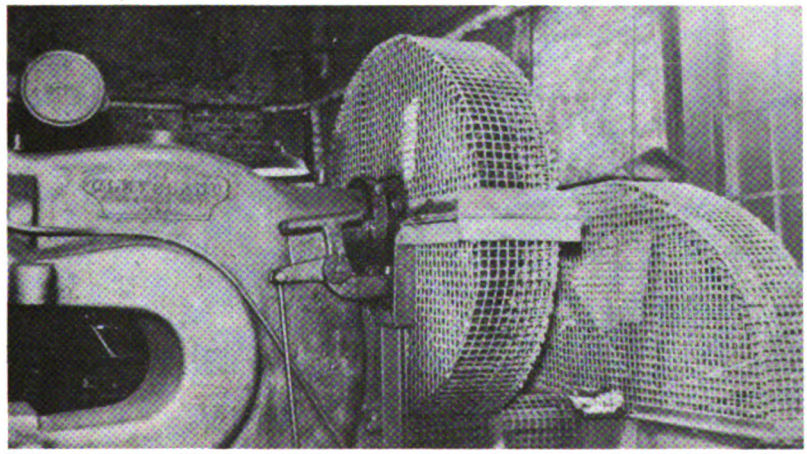


Figure 134. - Gear guard.

Screen guard enclosing the drive gears on a set of power shears. The guard is constructed of heavy-wire screen with metal pieces at the joints. The sections are bolted together and can be removed easily. Openings in the screen are sufficiently small to prevent any part of the body from coming in contact with the guard.

Generated on 2024-09-19 19:11 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Figure 135. - Open-stope stairway.

Where ladders are placed on relatively flat angles, workmen frequently try to walk upright on them, thereby creating a serious falling hazard. Here the standard mine ladder is converted into a stairway by the addition of horizontal treads and a handrail. The steps are made of 2- by 6-inch or 2- by 8-inch material, depending on the inclination of the ladder. Each step is notched to fit between the stringers, rests on the rung, and is secured with nails.

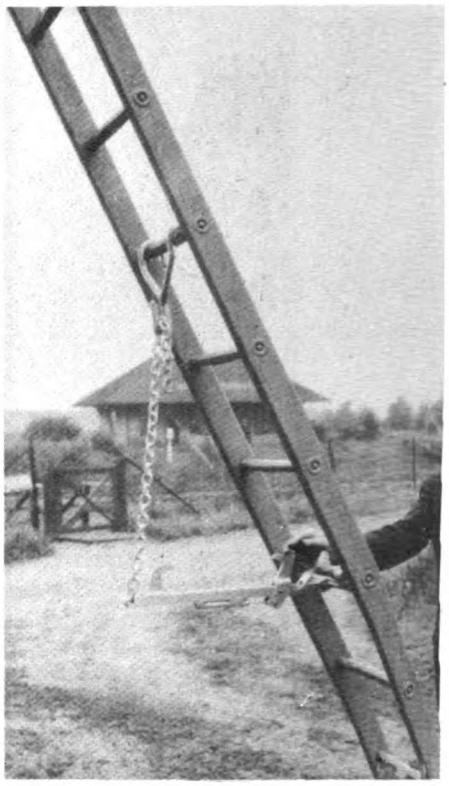


Figure 136. - Staging ladder clamp.

Ladder and clamp used to support one end of a staging board or scaffold. One end of the device clamps to the ladder rung and the other end is suspended by an adjustable chain and forked hook from a higher rung. The board is held firmly in place by two hooked fingers, one of which has a spring action.

Generated on 2024-09-19 19:15 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

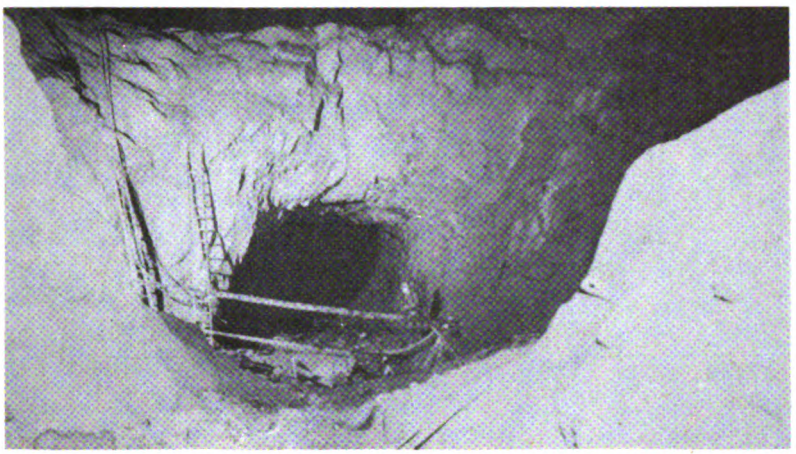


Figure 137. - Guarded mill hole.

This guard is to prevent miners working in the open stope from accidentally walking or falling into the connecting mill hole. The ladders at the left are for inspection of and barring loose ground from the walls of the stope.

Figure 138. - Raise gate.

Looking down an inclined manway-and-supply raise. The gate is made of round poles and is hinged on the hanging-wall side of the raise. When timber or other supplies are to be hoisted, the loose end of the cable is lowered through the wide slot and the load is attached. During hoisting, the gate is pushed open by the load, and it again falls into place when the load has passed. The ladderway at the right is covered with a solid door at the same elevation as the gate. Such an arrangement can be installed at intervals in a long raise, thereby limiting the distance of fall of men or materials should such an occasion arise.

Generated on 2024-09-19 19:11 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Figure 139. - Manway gate.

This gate over a manway raise has a wood frame covered with heavy meshed-wire screen to prevent material from falling and to permit free circulation of air. Note the handrail at the top of the ladder. A company rule is quoted: "Ladders shall project three feet above the sollars, or otherwise handrails shall be provided."

Figure 140. - Raise collar.

Collar of an air-and-timber raise. The "timber boat" used to hoist or lower timber is standing beyond the raise. The slide on which the boat travels is installed flush with the top of the ladder. The signal line at the left connects with an air whistle for use in handling timber. A three-section metal gate covered with heavy wire screen completely covers the top of the raise. One section of this gate is shown open. Other sections can be opened when required.

Generated on 2024-09-19 19:12 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

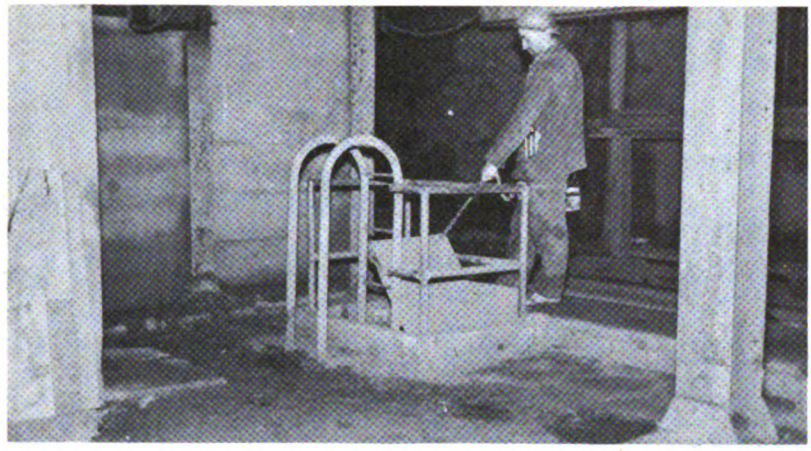


Figure 141. - Guarded ladderway.

Guardrail and trap door over the top of a ladderway leading to the loading pocket in a vertical shaft. An attached chain provides easy opening of the door. The steel ladder extends above the floor and provides a secure handhold when ascending or descending the ladder. The welded pipe guard and concrete toeboard prevent men or material from falling into the opening.

Figure 142. - Safety gate.

This gate is used over a manway raise at a sublevel in an underground mine. The gate is constructed entirely of metal and is hinged on the hanging-wall side, so that the entire manway can be opened for transporting large pieces of equipment. Near the center of the covering is the hinged gate for man travel. The openings in the covering are small enough to prevent large pieces of material from falling down the raise and at the same time offer minimum resistance to the ventilating current.

Generated on 2024-09-19 19:20 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

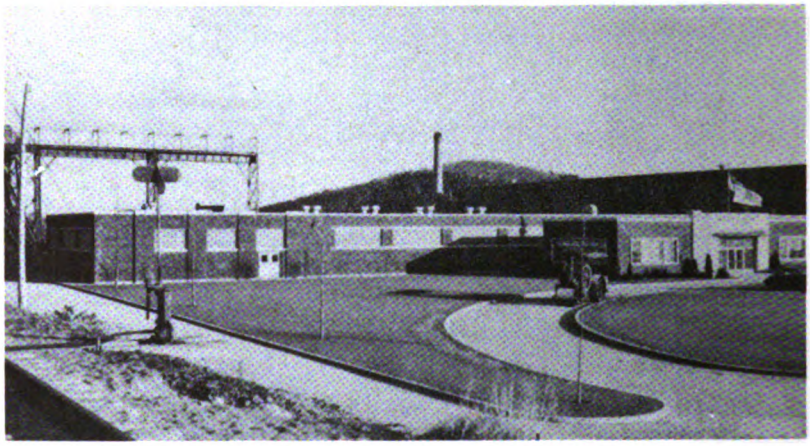


Figure 143. - Surface plant, underground mine.

An attractively landscaped surface plant at an underground mine. The one building houses all the machinery, supplies, shops, offices, and change rooms necessary to the operation of the mine. Maintenance inside as well as outside is neat and orderly. These conditions, indicative of good housekeeping, undoubtedly make for safer and better working surroundings.

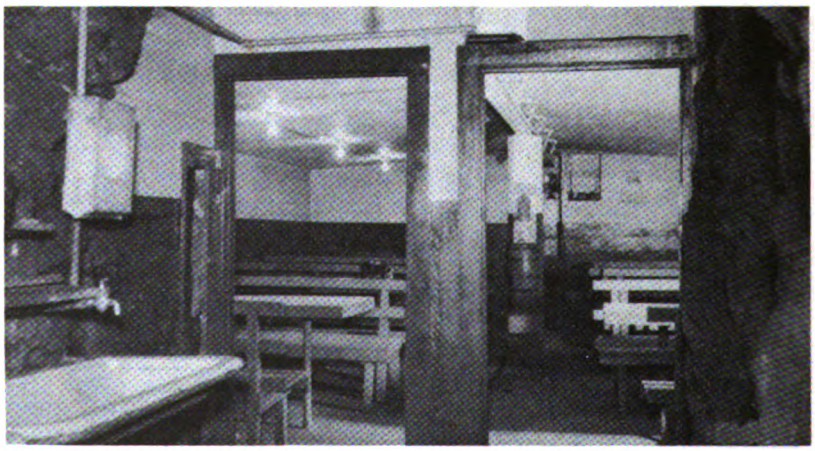
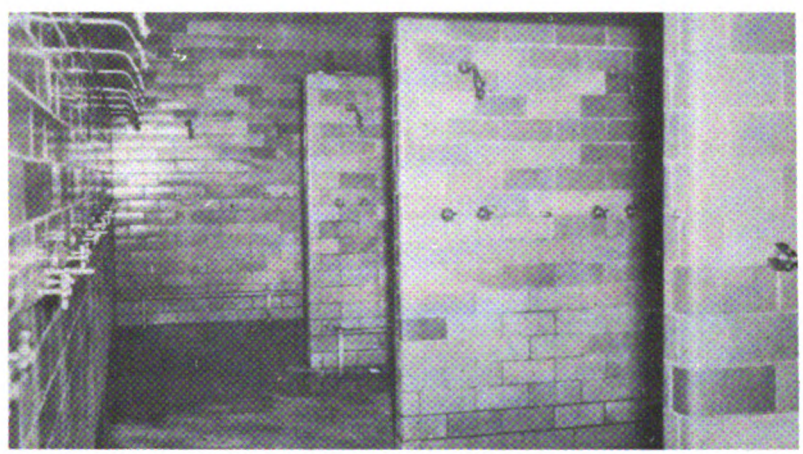


Figure 144. - Underground lunchroom.

Several mines maintain lunchrooms on the main operating levels. The back of this room is supported with steel members, and the entire room is lined with concrete. Tables and benches are provided for the men, and the room is ventilated by an electric fan. Washing facilities, including paper towels and soap, are provided at the entrance.

Generated on 2024-09-19 19:12 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

A.



B.

Figure 145. - Shower facilities.

Shower room in a modern change house at an underground mine.

"A" was photographed from the entrance haulway and shows the arrangement of shower heads and water valves in one of the curtain-walled sections of the room.

"B" shows the various sections or stalls in the room. Note the foot rails.

This room is equipped with 75 shower heads and is piped for liquid soap, the dispensers being located between the shower valves.

Generated on 2024-09-19 19:10 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

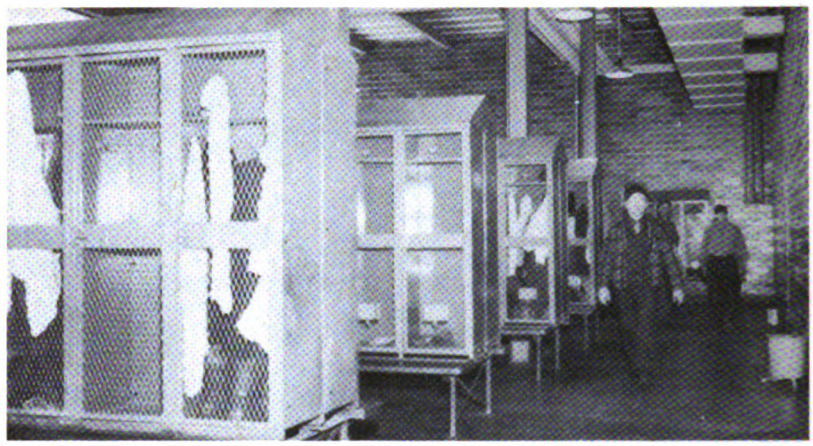


Figure 146. - Clothes lockers.

Steel lockers for street clothes in a change house. The lockers are raised to facilitate cleaning the floor and ventilating the lockers.

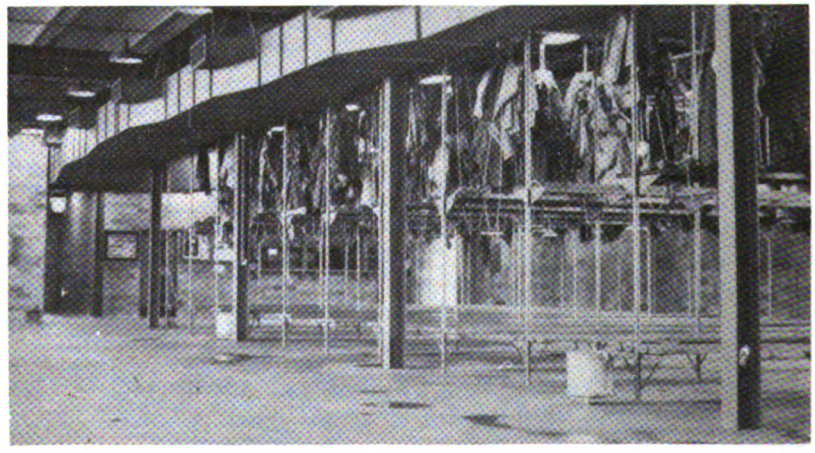


Figure 147. - Clothes hangers.

Mine-clothes room in a change house at an underground mine. The clothes hang from the ceiling on a chain hanger so that the air from the ventilation duct is effective in thoroughly drying the clothes.

Generated on 2024-09-19 19:11 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Figure 148. - Change house towel room.

A few mines furnish towels to their employees. At this mine a room is provided between the showers and the street-clothes room for vending the towels. The change-house attendant puts the clean towels on the numbered rack and collects the used towels from the change room.

Figure 149. - Change house toilet facilities.

Toilet facilities are generally provided in rooms adjoining both the street- and mine-clothes rooms. Note the wash basin in the foreground and the towel dispenser to the left of the urinals.

Generated on 2024-09-19 19:13 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

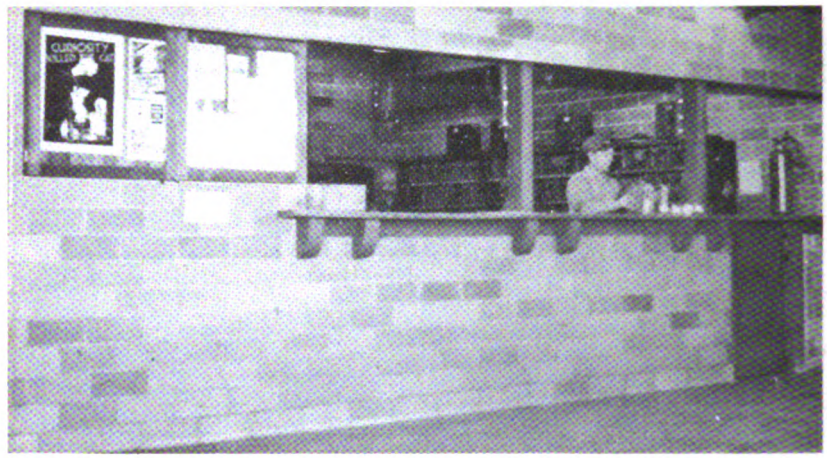


Figure 150. - Lamp room.

Lamp room just off the mine-clothes change room and near the tunnel door to the cage. The charged lamps are issued to the employees as they pass the window "going on" shift, and the used lamps are deposited at the same point "coming off" shift. The lamp-maintenance room is in one of the newer surface buildings. The use of electric cap lamps is standard practice in the underground mines of the district. Note the fire extinguisher just inside the "Dutch" door and the bulletin board to the left of the windows.

Figure 151. - Mine captain's office.

This mine captain's office is a part of his street-clothes locker room in the change house. Here are provided desk, table, and chairs where mine maps can be studied and procedures discussed with the shift bosses.

Generated on 2024-09-19 19:12 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Figure 152. - Dust sampling.

The midget impinger is in general use for dust sampling in the district. This sample is being collected during wet-drilling operations. The general plan with most companies is to collect dust samples throughout the mine in close proximity to each phase of mining at least once a month. The maximum allowable count varies for different materials and with different companies, but the general rule is that if the number of dust particles per cubic foot of air exceeds 5 million, the work must cease or the miners must use respirators until the condition is relieved.

Figure 153. - First-aid kit.

First-aid kit maintained underground for emergency use. It contains blankets, compresses, and triangular bandages. The box is moistureproof and the lid is secured with wing nuts, using a rubber gasket. The jar at the right side contains calcium chloride, a drying agent. The jar is screwed into its top, which is attached to the kit lid with an opening to the inside. Thus moisture is removed from the box, and the materials are kept dry and free from mold. The calcium chloride can be changed without opening the kit.

Generated on 2024-09-19 19:10 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

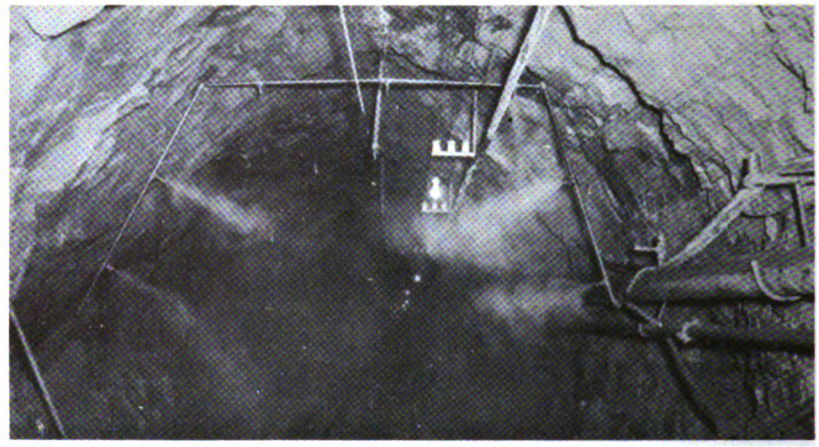


Figure 154. - Water curtain.

Water-curtain installation in a main drift for the suppression of dust in air which travels through other areas where men are working. The water curtain is produced by seven misting nozzles arranged around the arch of the drift. Each of these nozzles uses less than 2 gallons of water an hour, and the resulting mist remains in the air current for several hundred feet. The dust count is substantially reduced thereby.

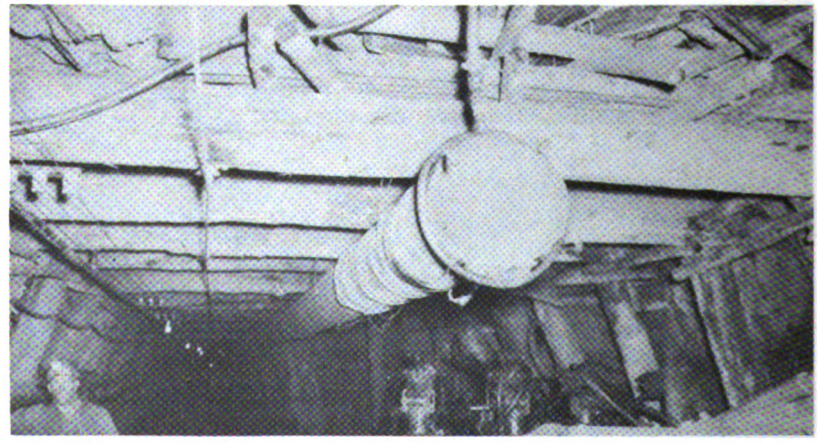


Figure 155. - Misting nozzles.

Exhausting ventilation tube equipped with four misting nozzles to suppress dust. The four nozzles, each using less than 2 gallons of water an hour, are set around the periphery of the tube at a slight angle to its diameter in order to cover the opening completely with a spray of mist.

Generated on 2024-09-19 19:15 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

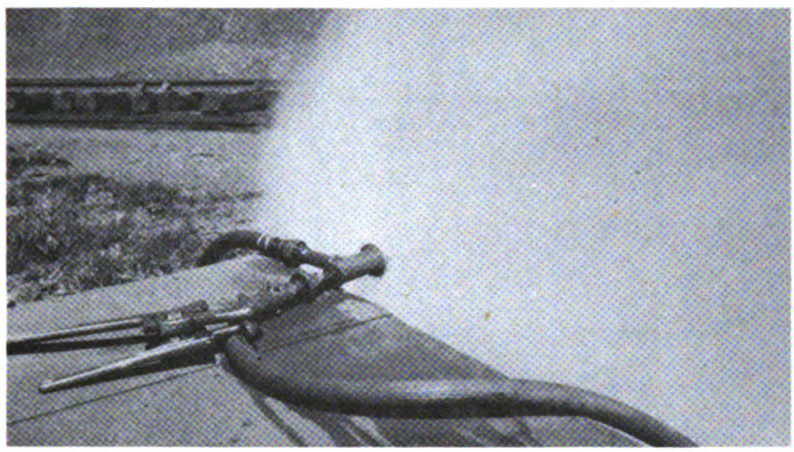


Figure 156. - Fog nozzle.

A compressed-air and water-fogging nozzle is designed locally, cast in a nearby foundry, and finished in the mine shop. When in operation, two streams of air and water emitted from around the periphery of the nozzle are impinged against each other, producing a voluminous fog. It is used in settling dust from blasting operations.

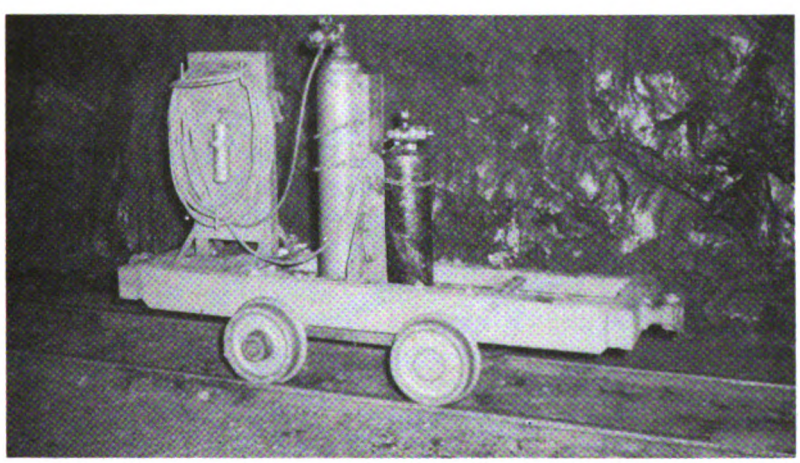


Figure 157. - Acetylene-welding and cutting unit.

Acetylene-welding and cutting unit trackmounted for use underground. A substantial metal bracket is provided on the truck to which the cylinders are secured. A second upright provides a convenient place to coil the hose and mount a fire extinguisher.

Generated on 2024-09-19 19:13 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

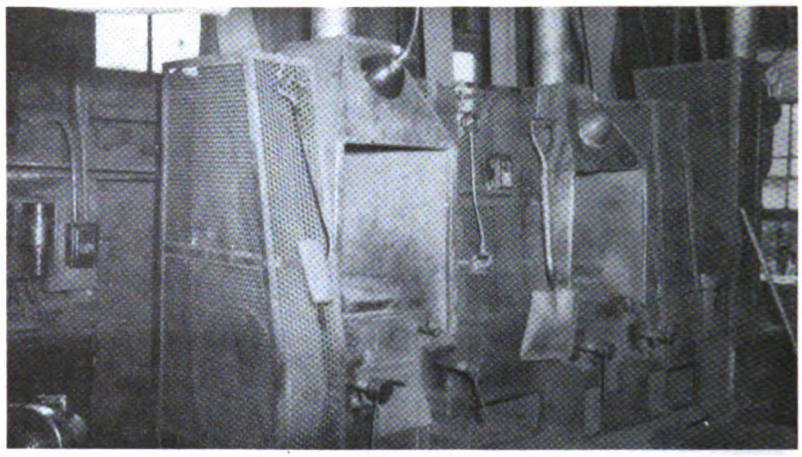


Figure 158. - Protected crusher operations.

Two sets of crushing rolls in a sample-preparation room. Each is equipped with a dust-exhaust hood connected to a central suction. The feed hoppers are equipped with grizzly bars (not shown), which prevent injury to the hands of the operator. The guards enclosing the drive belts are metal and of excellent design.

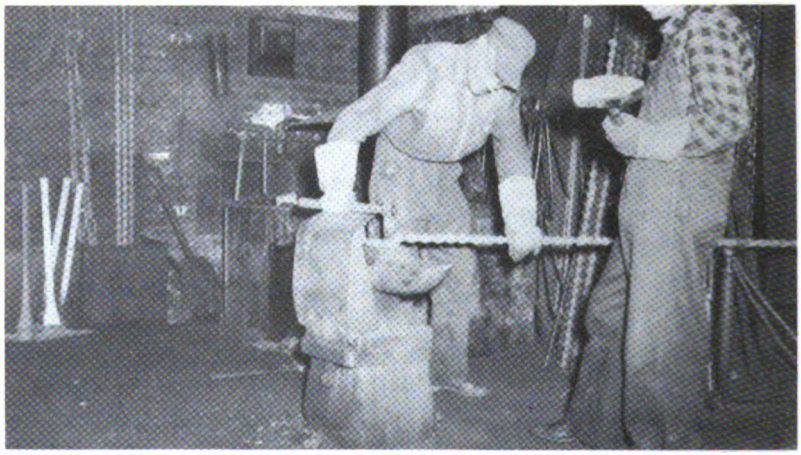


Figure 159. - Anvil spark arrestor.

Anvil equipped with a guard or "catch-all" to prevent small hot or cold cuttings from flying and causing injuries to employees in the shop. The guard fits into a slot at the base of the anvil and can be removed when not needed.

Generated on 2024-09-19 19:16 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

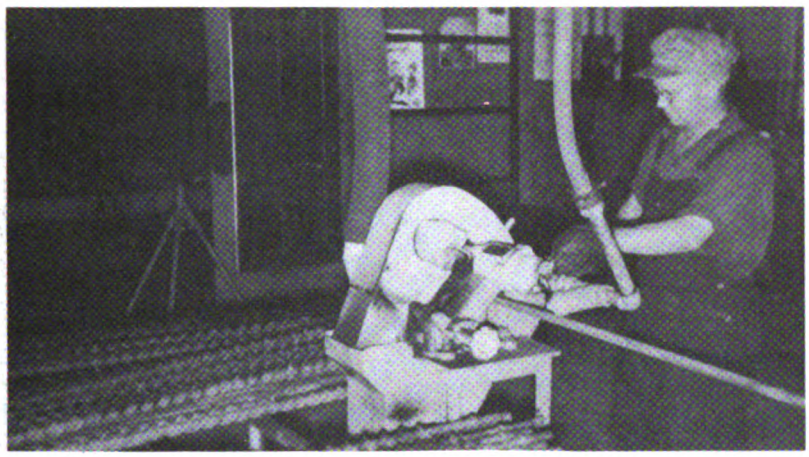


Figure 160. - Steel cutter dust collector.

Drill-steel cutter (abrasive-wheel type) equipped with a dust-collecting and exhaust system. The slot through which the shaft travels on its downward arc is covered with a stationary plate, which covers the opening. The dust-exhausting hose, or duct, connected to the hood is shown at the operator's left.

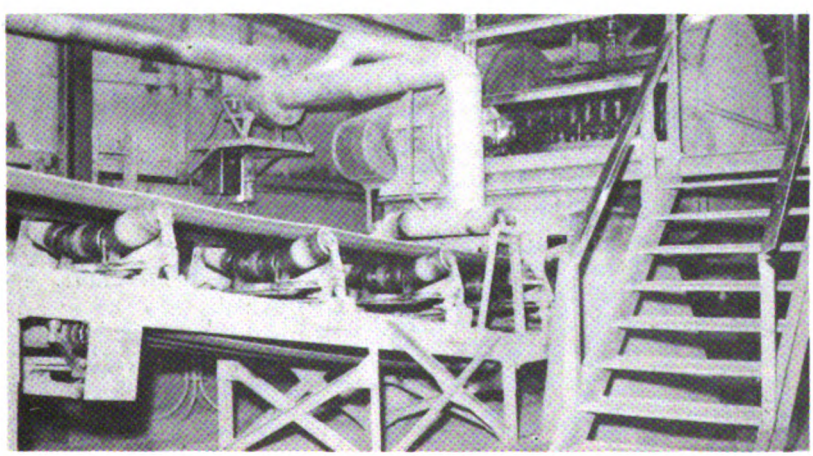


Figure 161. - Conveyor dust collector.

Dust-collecting system in a surface plant where ore is crushed, screened, and transported on belt conveyors. Dust-producing operations are enclosed by housings or hoods connected to an exhausting fan with metal-pipe ducts. This removes the dust, maintaining an atmosphere not detrimental to the health of workers within the building.

Generated on 2024-09-19 19:11 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

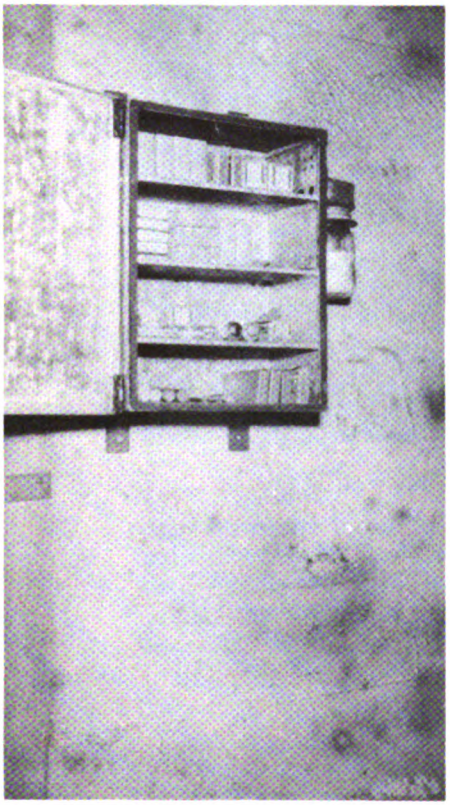


Figure 162. - First-aid box.

First-aid box permanently mounted at an attended location underground. The bottle at the right contains calcium chloride, which is used as a drying agent. All injuries, no matter how slight, should be given first-aid treatment.

Figure 163. - Emergency supply box.

Box containing first-aid materials and emergency supplies. It is mounted near the explosives magazine, where an employee is on duty at all times during working shifts. The box contains tools, rope, blankets, bandages, splints, first-aid manual, and first-aid charts.

Generated on 2024-09-19 19:15 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

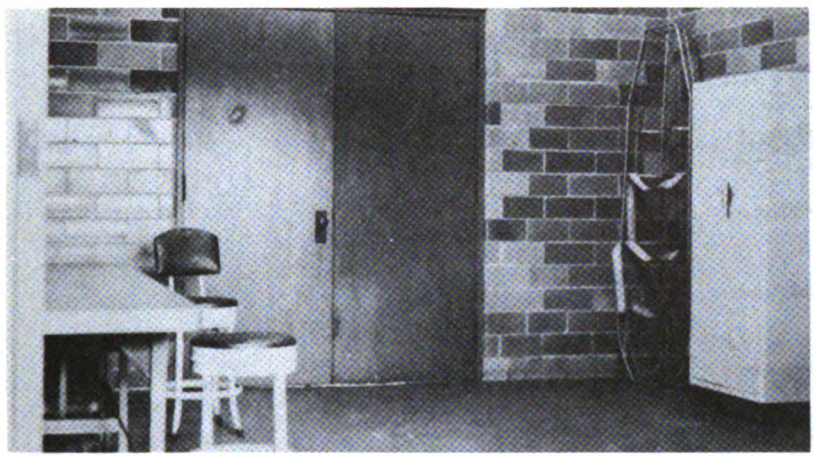


Figure 164. - First-aid room.

First-aid room adjacent to the mine-clothes room in a change house. A supply of first-aid materials and a stretcher are maintained. Facilities are provided so that in the event of a serious injury the physician can make a preliminary examination prior to transporting the patient to the hospital.

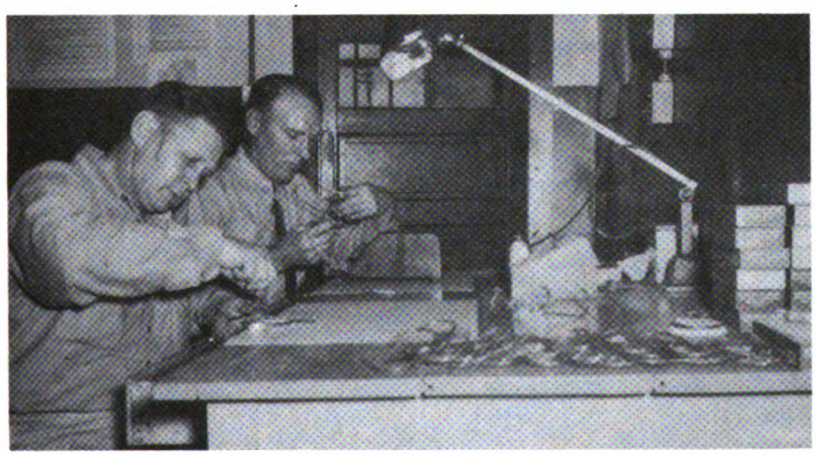


Figure 165. - Repairing safety goggles.

Safety-goggle repair operation in a first-aid and mine rescue station. Broken and worn goggles are repaired, fitted with the necessary new parts, and returned to service. The second man is using a midget electric welder to repair a broken frame.

Generated on 2024-09-19 19:13 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Figure 166. - Oxygen-cylinder rack.

The proper method of storing oxygen cylinders is in a secure and upright position. Here cylinders are held in place by a yoke slipped over the valve cap of the cylinder and pins permanently attached to the wall. A double row of cylinders can be secured to the same set of wall pins by using yokes of two designs as shown.

Figure 167. - Gasoline storage.

This storage tank is underground, and the vent pipe from it is showing at the right. The attendant is filling an approved gasoline can. The pump is protected by a cylindrical steel shelter house and supplies the fuel to gasoline-powered equipment working in an open-cut mine.

Generated on 2024-09-19 19:14 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

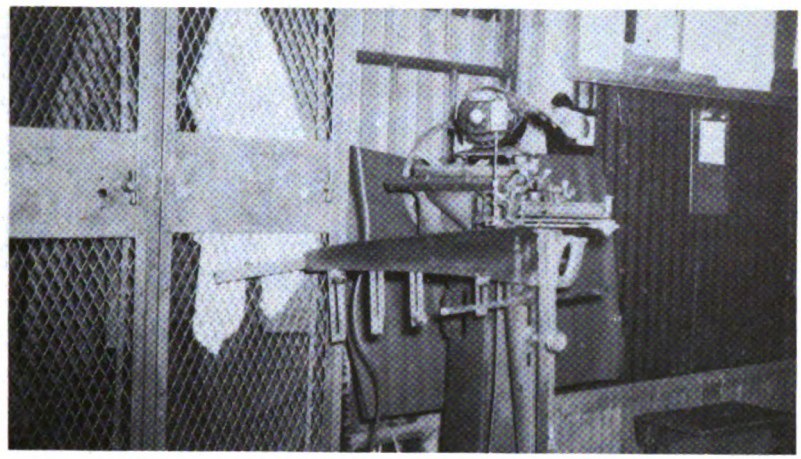


Figure 168. - Saw-filing machine.

An automatic saw-filer and jointer is driven by an electric motor. Once the saw is adjusted to the carriage, the entire operation of sharpening the saw is automatic.

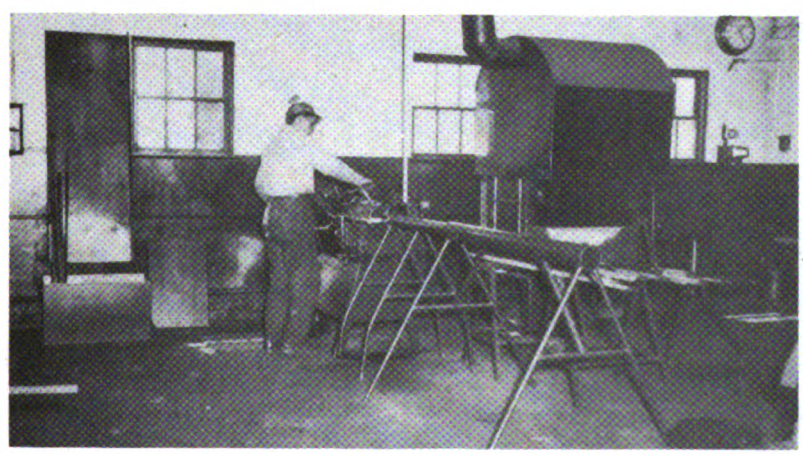


Figure 169. - Drill-steel guard.

Guard covering the rotating end of drill steel during threading operations. The guard consists of three telescoping sections of 4-, 3-, and 2-inch pipe respectively, supported on 1-inch-pipe legs. Thus the guard can be extended to protect the operator for varying lengths of drill rod.

Generated on 2024-09-19 19:15 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

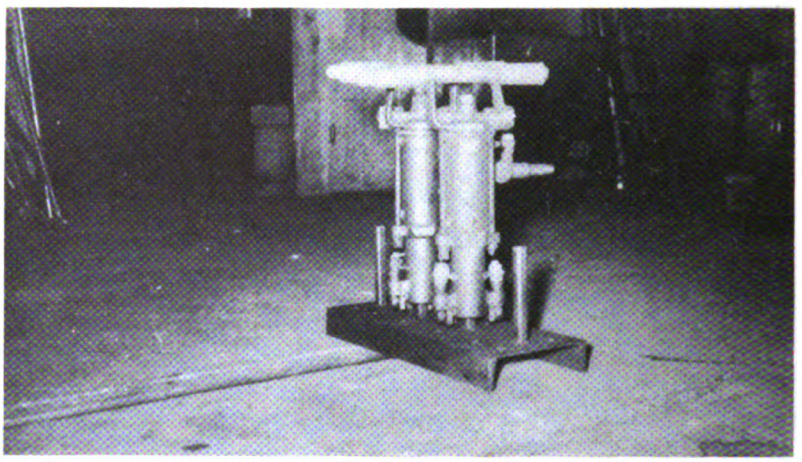


Figure 170. - Drill rack.

Stand or rack used in a shop to hold hand-held drills. It is a channel iron to which four short lengths of drill steel have been welded. This is a convenient method of racking drills and proves an adjunct to good shop housekeeping.

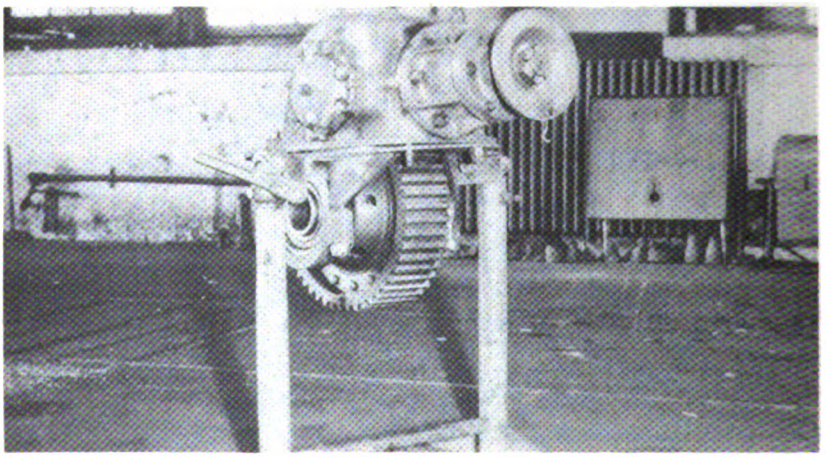


Figure 171. - Truck-differential repair stand.

A stand, to which a truck differential is bolted for repair work. The differential revolves and clamps in any desired position.

Generated on 2024-09-19 19:15 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

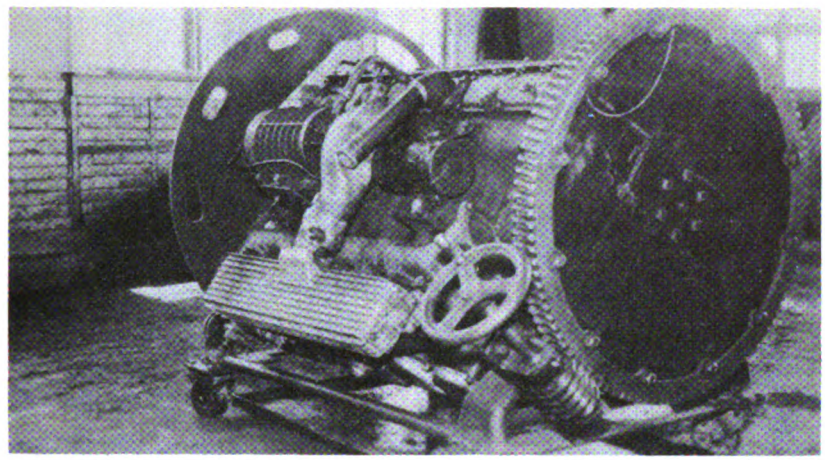


Figure 172. - Truck-motor cradle.

Cradle used to hold a truck motor for overhauling. The motor is secured to the cradle frame with stud bolts at each end, which fit into the regular taps in the motor block. The motor can be revolved to any desired position by operating the worm and ring gear. The cradle is mounted on wheels or casters, permitting it to be moved easily to any location in the shop.

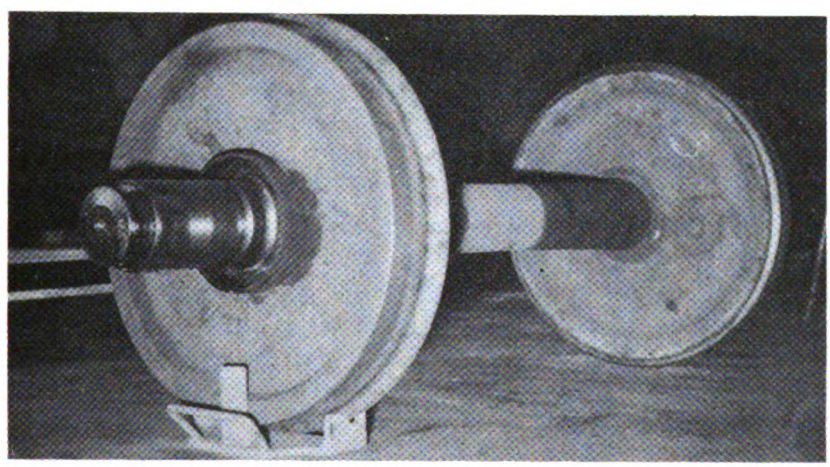


Figure 173. - Wheel block.

Metal device to block car wheels in a repair shop. Such a wheel block, used for that specific purpose, eliminates the use of other insecure or ineffective blocking.

Generated on 2024-09-19 19:14 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

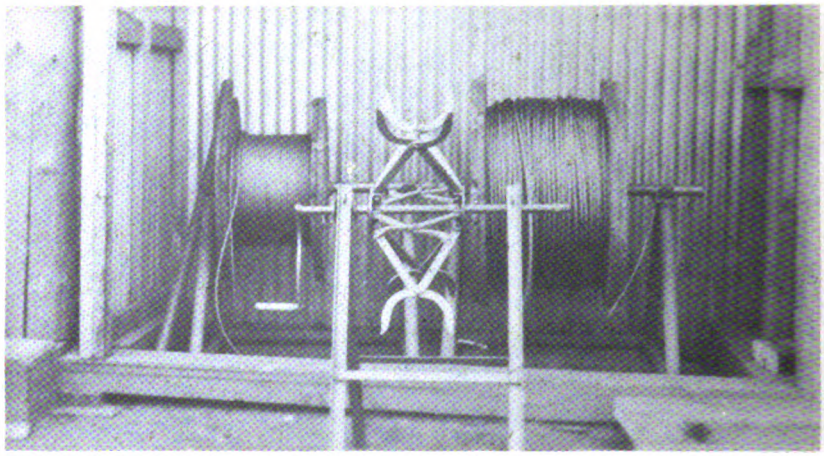


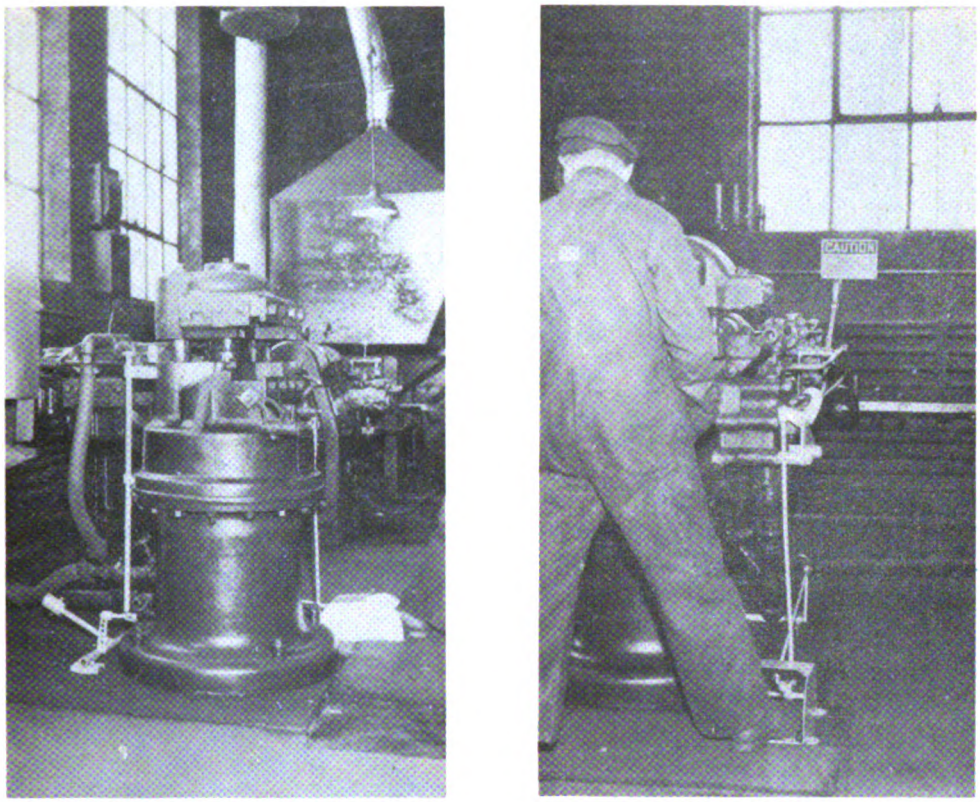
Figure 174. - Rope-coiling device.

Device for coiling desired lengths of wire rope to be taken underground for use. The desired length of rope is wound onto the reel, cut, and tied. A pin in the shaft is removed, collapsing the reel, and allowing the coiled rope to be removed.

Figure 175. - Detachable-bit wrench.

Wrench used for removing detachable bits from drill steel. It has advantages over the devices often used, such as a hammer or ax. A tapered chuck fastened to the drill carriage receives the bit and prevents it from turning. The wrench slips over the steel shank and engages the rotating lugs. This practice will reduce, if not eliminate, the eye injuries caused by flying metal chips resulting from striking the bit to remove it. Worthy of note is that the drill man is wearing a hard hat, electric cap lamp, safety goggles, and gloves.

Generated on 2024-09-19 19:14 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY



A. B.

Figure 176. - Guard on drill sharpener.

Guard on a drill sharpener to prevent injury to the hands of the operator. A guarded foot pedal is connected by a vertical rod to a latch that locks the operating valve on the sharpener. The pedal is also connected by horizontal rods and bell cranks to a vertical rotating rod that places a safety block between the movable head and the stationary base of the sharpener. A counterweight holds the safety block between the jaws of the sharpener and locks the operating lever, except when the foot pedal is depressed. The pedal is so located that the operator must be in proper operating position to depress the pedal. When in this position, it is hard to reach the dies and other mechanism at the back of the machine, where the majority of injuries occur. When the operator is changing dies, it would be very difficult for him to depress the pedal, consequently the sharpener is in a locked and safe condition. "A" shows the details of the guard and "B" shows the operator with his foot on the pedal.

Generated on 2024-09-19 19:10 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Figure 177. - Rip-saw guard.

Guard on a rip-saw that covers the saw blade and automatically adjusts itself to the thickness of the material being cut.

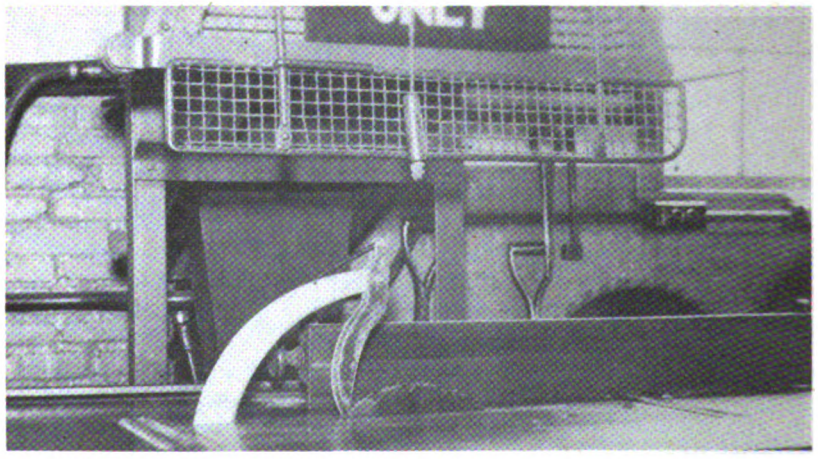


Figure 178. - Rip-saw guards.

Guard on a rip saw. It is counterweighted and adjustable according to the thickness of the material being cut. The guard is raised showing the anti-kick-back device attached to the splitter.

Generated on 2024-09-19 19:16 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Figure 179. - Band-saw guard.

Well-guarded band saw. The guard is adjustable to the thickness of the material being cut. The U-shaped piece at the base of the guard is intended to prevent a broken saw blade from flying out of the slot in the table and injuring the operator.

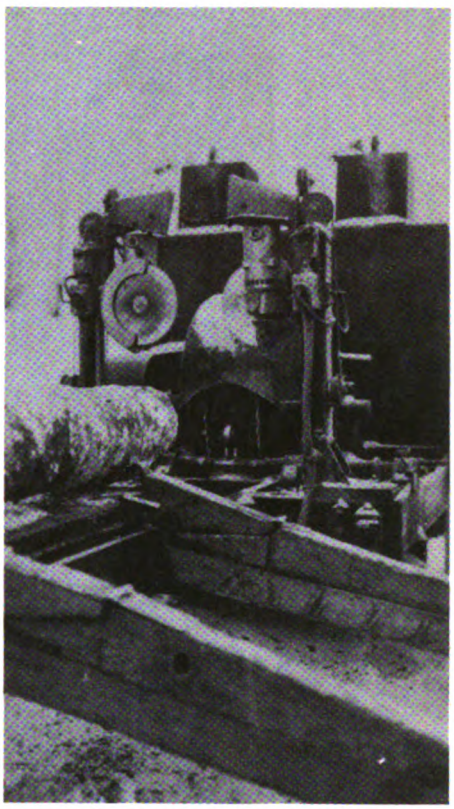
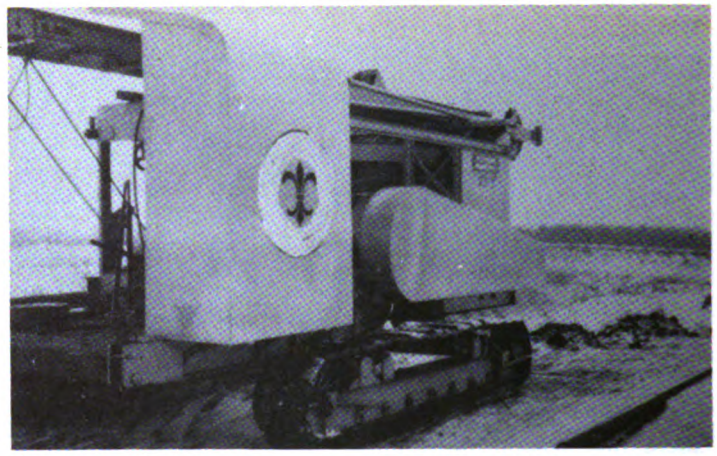


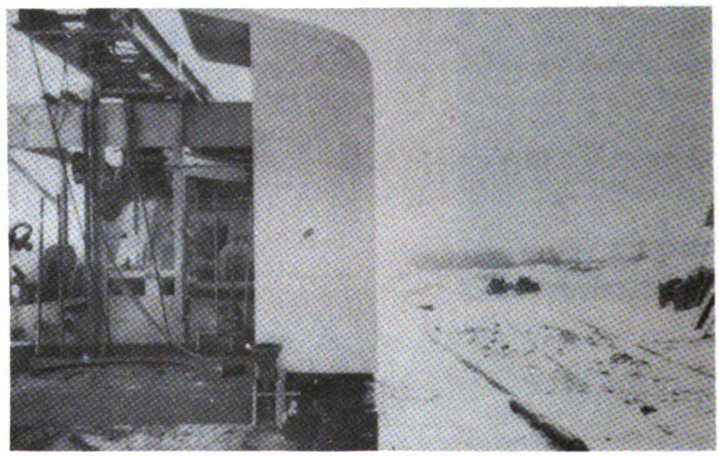
Figure 180. - Cribbing saw.

The power saw shown is used to frame cribbing. It is of local design and construction. Two parallel rip saws make the longitudinal cuts as the carriage is pushed forward. The framing is completed by two hand-held saws mounted on a vertical track and moved with a hand crank.

Generated on 2024-09-19 19:12 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY



A.



B.

Figure 181. - Churn-drill guard and housing.

There have been frequent injuries to operators of churn drills due to various causes. Injuries due to exposure in severe weather and inadequate guarding may be reduced by the installation and maintenance of proper housing for the operator and guards over the moving parts.

"A" is a side view of a drill equipped with substantial and effective guards and housing.

"B" is a front view of the same or similar installations.

Generated on 2024-09-19 19:12 GMT / https://hdl.handle.net/2027/osu.32435030643811
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY